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HIGH TECHNOLOGY BUSINESS

MAY 1988

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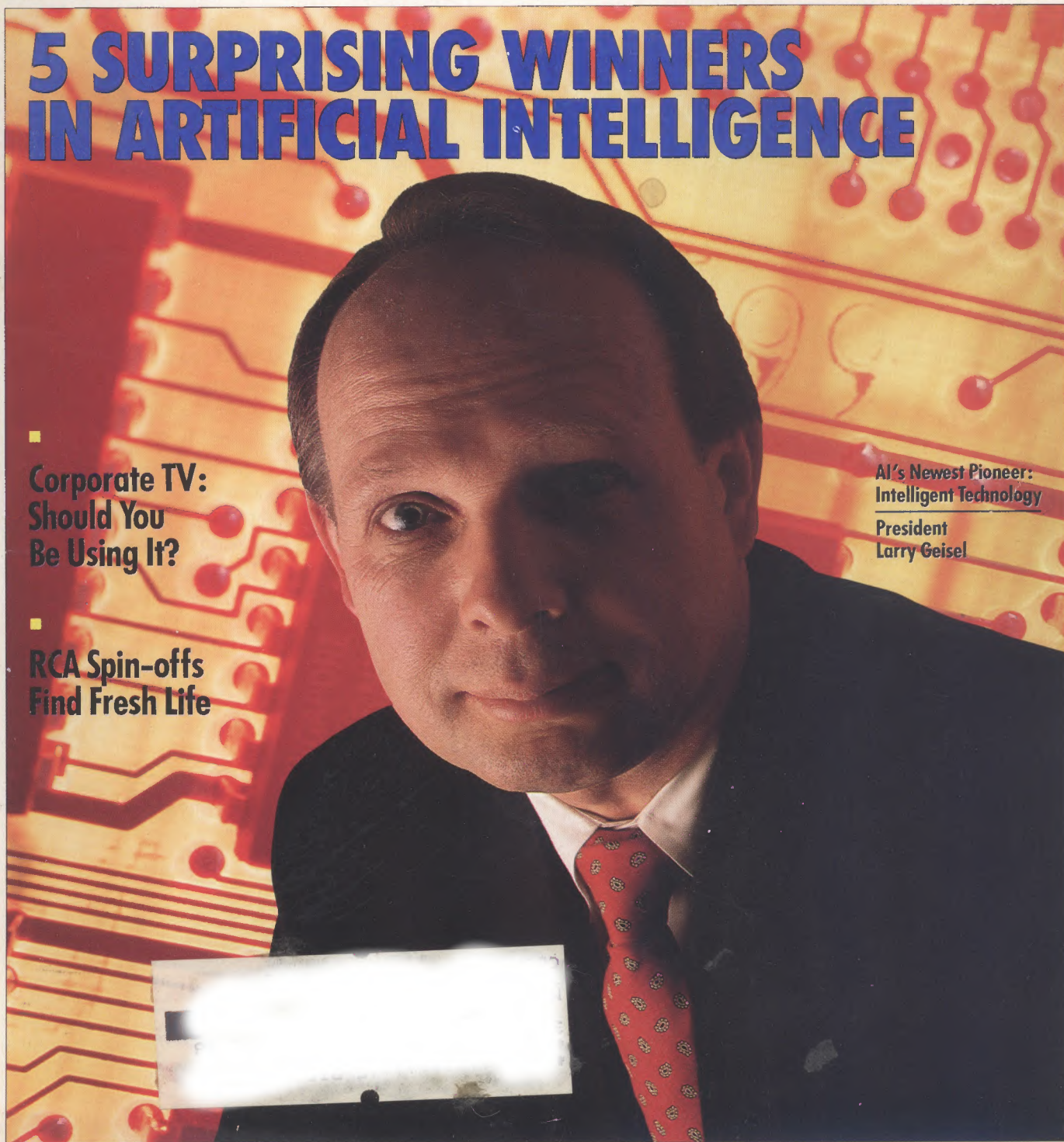
5 SURPRISING WINNERS IN ARTIFICIAL INTELLIGENCE

■ **Corporate TV:
Should You
Be Using It?**

■ **RCA Spin-offs
Find Fresh Life**

**AI's Newest Pioneer:
Intelligent Technology**

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HIGH TECHNOLOGY BUSINESS

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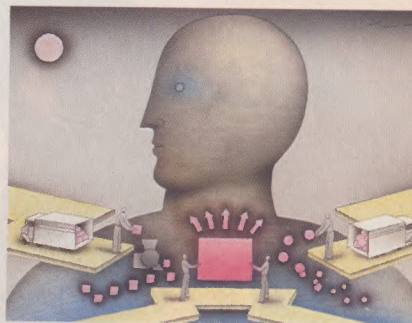
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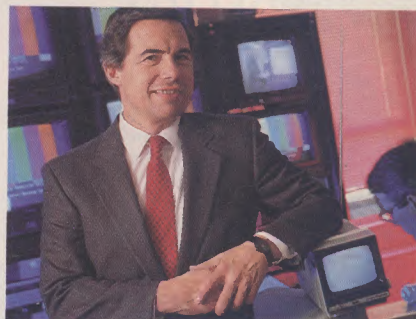
PERSONAL TECHNOLOGY Typing made easy; a telephone that remedies neck cramps; a stereo you wear.



Upstart companies retool artificial intelligence, p. 18.



Biotech banks on better ways to take medicine, p. 35.



Growth markets signal success for business TV, p. 26.

Cover photo by Brian Smale;
background photo by Steve Starr

Back By Popular Demand.

At one time, peregrine falcons nested by the thousands throughout the United States. But with the widespread use of the insecticide DDT in the 1940s and 1950s, the species suffered greatly. In the eastern U.S., the peregrine falcon disappeared entirely.

Now peregrine falcons have made a comeback, thanks to efforts by conservationists.

Since 1975 when recovery programs were established, 752 peregrines have been released in the eastern U.S., and there has been a steady increase in the nesting population.

With wise conservation policies, other once rare species such as the American alligator and the bald eagle have also made comebacks.

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Listening To the Market

SOMETIMES TECHNOLOGY just isn't enough. Case in point: artificial intelligence (AI), the subject of this month's cover story ("Rethinking Artificial Intelligence," p. 18). When AI software debuted commercially about five years ago, it was hailed for its technological superiority, which its developers claimed would enable it to mimic human thought and decision-making processes. AI companies expected customers to recognize their products' advanced abilities and invest the time and money to take advantage of those abilities.

However, buyers haven't exactly been jostling one another aside. As writer Alex Kozlov reports, many of the companies in the vanguard of AI development suffered losses last year, for various reasons. A prime factor has been the products' need for specialized computers whose cost can exceed the value of the sophisticated technology they support.

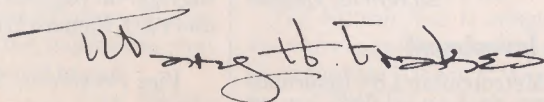
The lessons of the last five years have not been lost on newer companies, many of whom are succeeding by paying as much attention to market research as to technical research. These entrepreneurial ventures have focused on easy-to-use software that runs on computers customers may already own. As a result, the upstarts are making inroads in markets where artificial intelligence has been stalled, and the more established companies, such as Inference, are beginning to take note and adapt.

Over the next year, industry observers expect the split in the industry to become a pitched battle, with all the attendant acquisitions. The outcome of that feeding frenzy could help determine the shape of artificial intelligence outside the lab.

The story supports our conviction that in order to be knowledgeable about what technology holds for the future, one must consider not only the technology itself but also the business factors that influence which innovations reach the market and how they work in the real world.

Also in this issue, we look at what has happened to the segments of RCA jettisoned during GE's effort to streamline its operations after it bought the company in 1986 ("Picking Up the Pieces of RCA," p. 41). In many cases, the people who now own the divisions in which they used to work are finding that, because they understand their individual segments and the technology involved better than corporate management does, their spin-off businesses enjoy more flexibility and are more responsive to the market.

Which just goes to show that, even though technology alone may not be enough, technology and the right business conditions can be powerful allies.



Mary H. Frakes



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■ Risk and Reward

I FOUND THE ARTICLE "Compact-Disc Companies Test New Frontier" by Jeffrey Zygmunt in the February issue generally accurate and its overall conclusion difficult to challenge. However, as a consultant in the U.S. and European optical-disc industry, I take issue with the statement "[Philips] has probably invested the most in CD-I development, but is not expected to be a big player in the United States." After developing the technology and being a successful player in audio compact discs and countless other consumer-electronics products, there is no reason why Philips would not be a big player.

Philips has a major stake in almost every optical technology, and every compact disc made in the world earns the company three cents in royalties. Philips took a big gamble on audio compact discs and won big; CD-I is the next greatest challenge for Philips, and the risk and reward belong primarily to that company.

*Julie B. Schwerin
President
InfoTech
Pittsfield, Vermont*

I WAS QUITE impressed with the February article on interactive compact discs, finding it lucid, concise, and well-written. Interactive compact disc (CD-I) technology is on the leading edge of technology, yet you were able to guide the reader through its financial history, technical evolution, and market potential. Mr. Zygmunt's writing reinforced my belief that it is economically and socially critical that the average person becomes comfortable with new and developing technology. I thank you for doing just that for me with CD-I.

*Beth Enslow
Brooklyn, New York*

■ Operating-System Choices

AS A USER of both engineering workstations and personal computers, I find the OS/2 debate very interesting, as discussed in "IBM Opens the Door for Entrepreneurs" (March, p. 39). I have to agree that MS-DOS will definitely be

around until at least the early 1990s and probably much longer. I seriously doubt that the average home computer user will spend the big bucks necessary to convert from MS-DOS to OS/2. With my home computer doing everything I need it to do, there is no reason to change, and the business community will also take a hard look at costs vs. productivity before spending money to upgrade or replace all their machines.

In the workstation environment, Unix is fast becoming the standard operating system. Sun Microsystems uses it, and Apollo computer is changing from its proprietary operating system to Unix sometime this year. The customers of computer companies and OEM vendors are demanding standards and compatibility.

In a recent news article, the U.S. Air Force specified that systems had to be compatible with Unix V (DEC and Wang dropped out of the bidding). AT&T and Sun are conspiring to rewrite Unix, but did you know that Microsoft has its own conspiracy with AT&T to write Xenix and Unix into a new Unix system?

*Phillip E. Dent
Senior Technical Instructor
Auto-trol Technology Corp.
Denver, Colorado*

■ Handy Computers

YOUR NEW DEVELOPMENT item "Computer in Hand" (November 1987, p. 12) underestimates the usefulness of pocket computers in general and of the Psion Organizer II in particular. First, you did not mention that the memory of the Organizer II can be raised to more than 300 kilobytes. Second, having used pocket computers in education for more than two years, I feel that their small keyboards are more a psychological than a practical problem. Simply use the plastic cap of a ballpoint pen instead of the fingers.

*Henry K. van Eyken
Lakefield, Quebec*

■ Positive Investment

RECENTLY, Metropolitan Life Insurance Company, Tele-Columbus AG (a subsidiary of Motor-Columbus AG of Switzer-

land), and the University of Houston jointly invested \$8,500,000 in Houston International Teleport, a privately owned company that provides video, voice, data, and encryption satellite transmission services. We feel that a substantial amount of the positive response we received from potential investors was as a result of your article "Teleports: At the Crossroads" in the May 1986 issue.

*Dave Olson
President
Houston International Teleport
Houston, Texas*

■ A Well-Worn Superconductor

I COMMEND T.A. Heppenheimer for his excellent review of superconducting technologies and companies in the January issue. In 1977, GE Nuclear Energy installed a 7 Tesla superconducting magnet in its manufacturing facility in Wilmington, N.C. This magnet, which was built by Intermagnetics General, is the heart of an automated, nondestructive inspection system for nuclear-fuel-rod quality assurance. For more than 10 years, this superconducting magnet has been operated by production personnel on multiple shifts, logging more than 90,000 operating hours. We believe this application represents the world's first industrial use of a superconducting magnet.

*F.C. Schoenig
Manager, Automation Technology
GE Nuclear Energy
Wilmington, North Carolina*

■ The Whole Truth

IN THE TIME since Sue Ann Hawley interviewed me for her informative April article on emerging competitors in the computer-aided software engineering (CASE) industry, Index Technology has sold the 10,000th copy of its Excelsator CASE software. However, one point was as true then as it is now—the photograph on page 45 is of our president and CEO, Richard Carpenter, not of me.

*Chris M. Grejtak
Vice President, Sales & Marketing
Index Technology Corp.
Cambridge, Massachusetts*

■ Standard Objections

CONTRIBUTING EDITOR Andrew Seybold is a fly trapped in an IBM-generated amber, writing about the Intel 80386 as the standard for the next generation of desktop computers ("Picking the New Standard," January, p. 13). Here is a chip with a segmented addressing space, no on-chip instruction cache, and no operating system being touted as the next standard. Give me a break.

It may be an IBM standard, but it is obsolete technology designed to mainly run Intel 8080 code. The next generation of desktop computers will be graphics-based speed demons, and the 80386 doesn't have the horsepower to do the job. Try an 80386 machine running Microsoft Excel under Windows, and then try Excel on the Macintosh II. Plus, IBM's graphics environment hasn't even been written yet.

The Macintosh II's Motorola 68020 outruns the 80386 *today* in a graphics-based operating environment. Can you imagine what a machine based on the new, and shipping, Motorola 68030 will do? Has Mr. Seybold seen the demonstrations of Macintosh IIs boosted with Transputer (RISC—Reduced Instruction Set Computer) coprocessors? What about Sun Microsystems' and Fujitsu's RISC processor for the new Sun/4 workstation; this processor leaves the 68030 in the dust, and Sun has licensed the chip technology to AT&T and Xerox.

John S. Kundrat
Lewiston, Idaho

YOUR JANUARY COMPUTER column, "Picking the New Standard," made too much of Intel's 80386 processor. While speaking in glowing terms of the 80386, the article makes no mention of the Motorola 68000 series of chips that are already delivering what Intel promises, such as true multitasking on the Commodore Amiga. Motorola also makes chips that operate at faster clock speeds and offer graphics superiority, but Mr. Seybold does not mention them. The article falsely gives the impression that Intel is the only game in town.

John Walker
Houston, Texas

IN HIS JANUARY column, Andrew Seybold states, "...desktop computers built around the 80386 will be able to do something that heretofore has been the exclusive province of minicomputers: They'll be able to run several programs at once."

In November 1986, I purchased the Commodore Amiga 1000—a 512-kilobyte machine. It is capable of four-channel stereo sound, displays 4,096 colors at once, and *multitasks*. It has eight megabytes of random-access memory and can run as many programs as you can fit into that space, all at one time. (I can do a fair amount of multitasking in just 512 kilobytes.)

The Amiga has been recognized by many people as the super computer of the future, with many features you buy separate built into the main unit. As you have shown in your magazine, the biggest surprises don't always appear in the biggest packages. It's long past due that the Amiga gets the recognition it deserves.

William C. Lester
Elkins, West Virginia

Andrew Seybold responds: *Mr. Kundrat takes me to task for embracing the Intel 80386 as a standard. His points are well founded and, in fact, the Motorola 68000 chips are far superior to the 80386 chip. However, in determining a "standard" for corporations, it is also important to take into account the number of Intel processors already on desktops.*

Certainly there are better processors, but the fact remains that there is tremendous momentum already in place for the Intel chips, and developers will continue to offer innovative software based on this architecture. I disagree, by the way, with the comparison of Excel on a 386 and on a Macintosh II. I use both and have made numerous timing and recalculation tests; both perform well.

The bottom line is simple: there is no more popular desktop computer in corporate America than the Intel-driven IBM PC and its clones. I use both an 80386-based system and a

Macintosh II on a daily basis. I prefer the 386 for word processing and database applications and the Macintosh for anything requiring graphics.

In response to Mr. Lester, the Commodore Amiga 1000 is indeed capable of everything you say it is. It's a nice machine with a very attractive price. The Amiga's shortcomings have more to do with networking capabilities, the availability of software written for the serious business user, and the ability to interchange data with the installed base of Intel-based computers. Again, the article was not about what machine works best under all conditions, but rather what is the emerging standard giving momentum to the corporate purchasing decisions being made today.

■ More on the Amiga

MY COMPLIMENTS on your November cover story, "Workstation Wars." You mentioned the IBM PS/2 and the Macintosh II as upcoming low-end workstations, and I agree. But you failed to mention the Commodore Amiga.

The high-end Model 2000 supports a Motorola 68000 running at 7.16 megahertz; it displays color graphics at over one million pixels per second. Within a year you can expect the Amiga with a Motorola 68030 and the 68882 math coprocessor running at 25 megahertz, and a video board with more than 4,096 colors. Already, an accelerator board equipped with a 68020 running at 1.432 megahertz and a 68881 operating at 25 megahertz was benchmarked at five times faster than the VAX 11/780, and equal to a Sun 3/160. I understand that the Amiga cannot compare in all aspects to a professional workstation, but it surely should be mentioned before the Macintosh II or IBM PS/2 as a true low-end graphics workstation.

Scott Sbihli
Burton, Michigan

We welcome comments from our readers. Address letters to Editor, HIGH TECHNOLOGY BUSINESS, 214 Lewis Wharf, Boston, MA 02110. We reserve the right to edit letters for length and clarity.

New Developments

Issues, products

and advances

that help create

new opportunities

for high-tech

businesses

Patients Will Pay For Test Drugs

LAST YEAR, when the Food & Drug Administration allowed companies to charge patients for potentially life-saving drugs that had not yet been approved for general use, medical-technology companies greeted the ruling with great interest. But the industry has always questioned the ruling's benefit to both companies and patients.

The FDA's ruling created a new drug status—Treatment Investigational New Drug, or Treatment IND—for experimental drugs intended to treat serious or life-threatening illnesses. If no other treatment is avail-

able and the drug has been proven both safe and to do some good, companies can now dispense the drug and charge patients to recover development costs.

Several biotechnology companies, including Amgen, Ribic Immunochem, and Xoma, are considering applying for Treatment IND status for drugs in the final stages of human clinical trials. Warner Lambert received a Treatment IND early this year for Trimetrexate, which is used to treat AIDS-related infections. However, Stuart Weisbrod, an analyst at Prudential-Bache, thinks the biotech companies' enthusiasm may be shortsighted. A Treatment IND "allows [small companies] to break

even perhaps a year earlier, but in the long run, it will delay the approval process. Examiners may not approve [new drugs] as quickly because some patients now have a way to get the drugs."

Even more troubling is the question of who will pay for such drugs. Some companies, including Warner Lambert, do not plan to charge, but smaller companies can't afford to give their drugs away. The first Treatment IND, a drug intended to ward off a virus that attacks kidney-transplant patients, will cost about \$9,000 a year. Though several insurance companies are considering it, neither private nor government plans currently pay for unapproved drugs.

Color Documents Get Cheaper

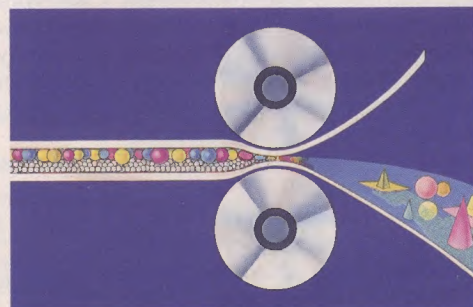
ANEW PROCESS for producing color documents provides an alternative to low-quality, inexpensive color copying and high-quality, expensive photographic

printing. The Cycolor process from Mead Imaging offers quality that approaches that of printing, but costs little more than copying.

Mead, based in Miamisburg, Ohio, has patented Cycolor film and paper, and several companies are devel-

oping printers and copiers to use the new system.

Cycolor film is coated with tiny magenta, yellow, and cyan (blue) dye capsules. Exposure to different colors and intensities of light hardens the capsules to varying degrees. The softer the cap-



The Cycolor process pops tiny bubbles of pigment to create images that rival the quality of photographs.



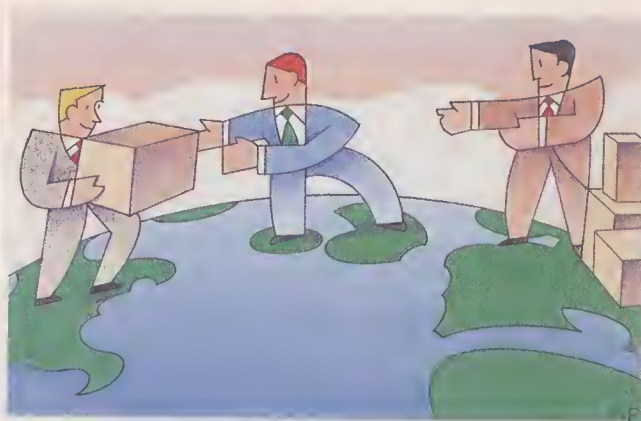
MEAD IMAGING

- Aging baby-boomers get bifocal contacts
- Disk drive makers challenge trade rules
- Teleconferencing services take on mass appeal

sule, the more color released when the film runs through rollers to print the image.

Because the Cyclicolor process does not need expensive silver halide, it costs only about 50 cents a print. Color photography and stats cost \$1 to \$15 per copy and require messy chemicals and technical expertise.

Companies that plan to introduce Cyclicolor printers this year include GreyHawk Systems of Milpitas, Calif., and Noritsu America of Buena Park, Calif. GreyHawk is making a computer printer; Noritsu, a slide printer. Other companies are working on printers for electronic cameras. In Japan, Seiko Epson is developing a Cyclicolor copier, and Brother, Seiko, and Dainippon Screen Manufacturing are also planning Cyclicolor hardware.



Overseas Marketing Gets Easier

WITH THE fall of the dollar, the European market has become even more alluring for North American high-technology companies. Smaller outfits can join the fray with the help of the Computer Pack-

aging Group of Britain's Ferrari Computer Services Ltd.

The Ferrari Group, a large computer-systems dealer, designed its HomeBase service for companies worth \$20 million to \$50 million, but some startups might use it as well, says Bob Denton, HomeBase vice president.

The service supports one-

person operations based in Surrey, England. Ferrari provides the logistics and warehouse facilities for European distribution, and subcontracts for all other services, including marketing and advertising. HomeBase also provides a financial package, legal services, shipping, and a shared-office complex.

A typical startup takes four to six weeks and costs about \$500,000 for the first year, not including the salary of the executive sent over to run the operation, usually at the vice-president level. Denton says that two companies have signed on—Scientific Micro Systems of Mountain View, Calif., a maker of peripherals for Apple Macintosh computers, and Southwestern Bell Telecom, which plans to sell telephone equipment in Britain.

MARK FISHER

Interactive Theater Targets the Rich

A THEATER network plans to offer satellite-transmitted movies and other events it hopes will appeal to affluent people over 40, who tend not to go to regular movie houses.

Gerald Smith, founder and director of Club Theatre Network, says his target group is the "top 2 percent of the population of the United States who control 28 percent of the country's disposable income." The company plans to operate small, posh theaters in exclusive country clubs, luxury high-rises, and resort hotels.

The programming—movies and "live" events such as plays, shareholders' meetings, and auctions—travels on microwave signals transmitted by satellite. Images appear on a large screen, and a proprietary processing system provides "enhanced-def-



Theatre network offers more than movies.

inition TV," with picture and sound quality the company claims is comparable to that of 35-millimeter film. A question-and-answer session follows each presentation.

Each theater seat has a keypad on the armrest and a headset. To ask a question, viewers push a button on the keypad. A computer keeps track of the questions and tells viewers when their turn comes. A device on the other armrest scans the magnetic

strip of a credit card to let viewers buy items they see during an auction or fashion show.

Club Theatre Network plans more than 400 presentations this year. The company opened its first theater at its headquarters in Boca Raton, Fla., and plans another for the Bonaventure Country Club near Fort Lauderdale. By selling franchises across the country, Smith hopes to open 25 theaters by year's end, with another 100 raising the curtain in 1989.

New Hope For Safe PCB Disposal

SCIENTISTS AT Texas A&M University have developed a way to use oxygen to deal with a particularly dangerous toxic waste.

PCBs, or polychlorinated

biphenyls, have been implicated in causing birth defects, cancer, lesions, and other health problems. The only known method of getting rid of them—incineration—creates small amounts of dioxin, an even more toxic substance.

The researchers at Texas A&M University have used a chemical reaction involving superoxide ions (oxygen atoms with an extra electron) to convert PCBs into a harmless mixture of bicarbonate of soda and salt, without creating dioxin.

Chemist Donald Sawyer, leader of the group that developed the superoxide process, hopes that the technique will break down the coolant byproduct for as little as 10 to 20 cents per pound. Burning PCBs currently costs \$1 per pound. The Texas A&M team is working on a device to make the process practical for the commercial market.

ACEY HARPER



MALYSZKO

When exposed to the sun, Xytron patches change color to help prevent burning and skin damage.

Patch Monitors Exposure to Sun

TANNING IS big business, but dermatologists warn that spending too much time in the sun can be dangerous. To help measure how much exposure a person's skin has received, Xytronix Inc. of San Diego, Calif., has developed strips of treated plastic that change color as they absorb the sun's

damaging ultraviolet rays.

A chemical in the strips reacts with these rays, which cause both tanning and burning. The disposable strips come with a color chart that interprets how much radiation has been absorbed to help sun worshippers decide whether it's time to add sunscreen, turn over, cover up, or head inside.

Xytronix has filed for a patent on the strips and is

seeking a corporate partner to market the product by next summer, according to chairman Peter Baram. He expects a box of the sun-sensing strips, called Xytron, to sell for about \$5.

Baram also sees marketing opportunities for his company's product off the beach. Because the brightly tinted strips change color in the sun, they might be used in toys and novelty items.

Riding the Semiconductor Boom

THE RECOVERY of the semiconductor market will also bring prosperity to companies that serve the chipmakers.

"During the last few years, the depressed semiconductor industry put off needed capital spending," says Michael Gumport, an analyst at Drexel Burnham Lambert. Pent-up demand means that sales of microlithography machines, which sketch circuit designs onto computer chips, should increase from \$450 million in 1987 to \$800 million by 1990, says Gumport. Perkin-Elmer Corp. of Norwalk, Conn., re-

cently introduced a machine combining the best of earlier microlithography technologies that could increase the company's market share from 20 to 25 percent in the next two years.

Other production companies expected to show strong sales in the near future include Applied Materials Inc. of Santa Clara, Calif., and Advanced Semiconductor Materials of America Inc., based in Phoenix, Ariz.

Companies that make test and inspection equipment are also expected to outpace the growth of chip companies. "If the semiconductor industry grows 20 percent, as we expect, the test-equipment companies could grow

40 percent," says analyst Charles Hill of Kidder, Peabody. He attributes this growth to increasing chip complexity, which heightens the need for sophisticated, expensive test equipment.

For example, KLA Instruments of Santa Clara offers a new wafer-inspection machine that should help boost sales by 25 percent this year. The device scans chips that have become too complex for the human eye, even under a microscope.

LTX Corp. of Westwood, Mass., also has a new product for inspecting advanced chips that perform digital calculations in computers. The company's sales growth could hit 40 percent in 1988.

Technology Is Good Business

DESPITE occasional disappointments and disruptions, the vast majority of U.S. business people think technology has been good for American business.

In an exclusive HIGH TECHNOLOGY BUSINESS survey of 988 corporate decision-makers, more than 89 percent say that technology, and computers in particular, has had a positive effect on the way U.S. businesses are managed. Just over 6 percent say technology has had no effect, and fewer than 4 percent of the respondents feel that technology has had a negative impact.

A significant percentage of the negative responses come from the group aged 30 to 64, many of whom remember a workplace without computers. Although more than half of the negative respondents hold white-collar jobs, poorer respondents tend to judge the effects of technology more harshly than do their more affluent fellows. Male and female respondents show no significant differences in opinion on the subject.

HTI Custom Research conducted the survey for HIGH TECHNOLOGY BUSINESS.

How has technology affected U.S. business?

Positively	89.3%
Negatively	3.5%
Neither	6.1%
No answer	1.1%

Disk-Drive Group Wins Tariff Tiff

IT WAS A CLOSE call, but manufacturers of disk drives appear to have halted a federal tariff action that could have cost them \$70 million a year. Emboldened by the victory, the group of companies hopes to evolve into a trade association to promote the industry's causes.

The group formed to fight a U.S. Customs decision to reclassify disk drives as finished products rather than components, thus making them subject to a 3.7 percent import duty.

Even though disk drives form a \$3-billion business, the industry had no central organization to fight the customs decision. George Scalise, president of disk-drive maker Maxtor of San Jose,

Calif., enlisted eight competitors—Cipher Data, Conner Peripherals, Control Data, Tandon, Miniscribe, Priam, Quantum, and Micropolis—to form a consortium to successfully fight the change.

It's Not the Heat, It's the Humidity

MOST VENTILATION systems ignore the fact that humidity can be as important as temperature in determining comfort. But a system from France's Aereco adjusts airflow in relation to moisture content.

The system uses hygrometers to measure humidity in each room. Ventilators detect and regulate air flow to maintain a comfortable level throughout a house. Kitchens and bathrooms, for ex-

ample, generate more humidity than bedrooms, and the Aereco system adjusts the air flow to compensate.

The sensor, a small box installed in a house's ventilation ducts, consists of eight nylon strips and an actuator. Changes in humidity make the nylon strips stretch or shrink, and the actuator senses the changes to control ventilation.

Light/Dye Process May Boost Displays

A PROCESS involving light and dyes promises dramatic advances in flat-screen color imaging and integrated-circuit manufacturing.

The process, still in the early stages of research at the University of California

at Irvine, creates color images by projecting a narrow beam of ultraviolet light—from a laser, or controlled through a stencil—onto a semiconductor coated with light-sensitive dye. The dye changes color when charged by the laser. Different dyes provide the full spectrum of colors, and a small electrical charge "erases" the image, changing the dye back to its original color.

The technology could be used to make flat-screen television sets and color displays for aircraft and medical-imaging equipment. Ford Aerospace & Communications Corp., which helped fund the research, plans to use the process to make infrared sensors. Researchers also hope to use the process to make silicon or gallium-arsenide semiconductors.

ALSO WORTH NOTING



The first digital-audio-tape decks in the United States will go in cars.

■ At long last, Asian electronics companies are about to bring decks that use digital audio tape (DAT) to the United States. But the decks will first appear as play-only units, even though the technology is famous for its ability to make flawless copies of digital recordings. DAT recorders are already out in Japan, but because of the battle over a scheme to prevent DAT decks from copying digital recordings, the first DAT machines in U.S. stores will probably be car

players that cannot record. Companies such as Clarion, GM's Delco, and Sony (for Ford) hope to introduce systems for cars this year.

■ The precision drug delivery promised by monoclonal antibodies means doctors can reduce side effects by prescribing lower doses. The increasing use of monoclonal antibodies to deliver cancer chemotherapy drugs may cut the cancer-patient market for pain relievers by about 40 percent from its current \$200-million level by the mid-

1990s, says analyst Cal Reddy of market-research firm Theta Technology. The decline will affect drugs from Johnson & Johnson's Tylenol with codeine to Du Pont's Percodan, as well as morphine.

■ Visa International has received a U.S. patent for a system that enables standard magnetic-strip readers for credit cards to read the new "smart" cards, which contain computer chips. The invention should smooth the way for widespread acceptance of Visa's SuperSmart Card for use in electronic authorization and data-capture terminals.

■ Spurred by the discovery of the hole in the protective layer of ozone in the atmosphere over Antarctica, the Environmental Protection Agency is exploring ways to limit the use of chloroflu-

orocarbons, or CFCs. These emissions are thought to be partly responsible for the breakdown of ozone in the stratosphere. The EPA is putting pressure on electronics companies to cut down on the use of CFC-113, a solvent used in many electronics processes.

■ The wait for Food & Drug Administration approval of genetically engineered products may be shorter than expected. Wall Street analysts usually figure on an 18- to 24-month delay for the FDA to issue marketing approvals of biotechnology products, but the eight biotech products approved since 1982 waited an average of only 15 months. Companies filing for FDA approval on new products this year include T Cell Sciences, Exovir, and Amgen.

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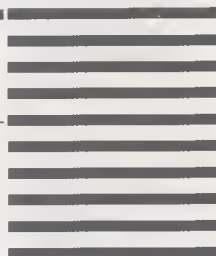
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Making Cautious Changes

SWITCHING OPERATING SYSTEMS REQUIRES PLANNING

■ By Andrew M. Seybold

THE NEW OPERATING system developed jointly by Microsoft and IBM—OS/2—has been available since the first quarter of 1988. The system, designed to take advantage of the increased power and memory of computers based on Intel's 80286 and 80386 chips, promises to improve productivity on corporate desktops everywhere. Eventually.

The problem is that what's available now is only the first version. The Extended Edition, which will have a database manager and a communications manager, is due to be released in July (a later release of the Extended Edition will also include a program to manage local-area networks). The most important enhancement to the basic system—the graphics-based Presentation Manager—won't be here until Microsoft ships version 1.1 of the basic edition sometime in the fourth quarter. (Presentation Manager is the Macintosh-like user interface that is supposed to simplify the use of applications software and the transfer of information from one program to another.)

Because OS/2 will arrive piece by piece, and because changing operating systems is a costly upheaval even under the best conditions, corporate planners have some difficult judgments to make.

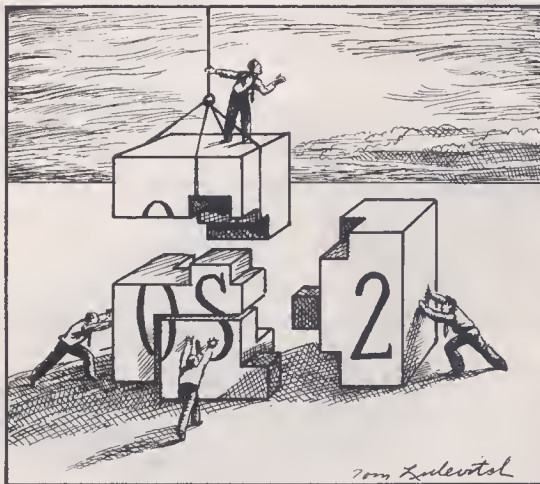
The first question they must answer concerns timing. Is it better to stay with their old operating system—waiting to see whether promised enhancements appear—or should they leap into OS/2 immediately? There's no "right" answer, but here are some points that should be considered when weighing the costs and benefits.

First, the down side:

■ Although existing programs can run under OS/2, they do so only in a DOS "window" that takes up 512 kilobytes of

random-access memory. Communications software and other programs that rely on the computer's clock may not run in this window.

■ The cost of moving to OS/2 is more than just the \$795 for the operating system, plus the price of new software. OS/2 works only in machines that have 80286 or 80386 processors; earlier models must be upgraded. A desktop com-



puter will need at least an EGA-display adapter and monitor, two megabytes of random-access memory, and a large amount of hard-disk storage. Also, the Presentation Manager interface works best with a mouse.

■ Training will be needed. No matter how good the OS/2 system may turn out to be, employees will have to learn new ways of working.

Now for the up side:

■ With OS/2 and Presentation Manager, IBM computers and their clones will finally begin to offer the benefits of a consistent user interface (benefits that Macintosh users have taken for granted for several years). It will no longer be necessary to install software packages and tailor them for each machine. Printers, mice, keyboards, and other devices will all be handled directly by the operating system.

■ Training people on new software will be easier with OS/2. Once users are up and running under the new system, they won't need instruction each time they move to a new piece of software.

The timetable for release of OS/2-specific software is unclear. The initial releases have been new versions of software that was already available under DOS. It's a safe bet, however, that by the end of 1988 and early 1989 we will see entirely new OS/2 programs that take advantage of the system's advanced capabilities.

How should corporate planners proceed in the meantime? Here are some suggestions:

■ Obtain a few copies of OS/2 and start learning how to install and use it on your systems.

■ Plan to put OS/2 on those desktops that already have the equipment to handle it.

■ Arrange to "hand down" those personal computers that can't run OS/2 to people who can use them for specific DOS applications. Or, make such computers into net-

work workstations—OS/2 and DOS can coexist on one network.

■ Plan to spend as much time installing new applications as you did with DOS.

■ Allocate a considerable amount of time for initial training.

■ Plan to go through the software-evaluation process all over again.

It makes sense to move into the OS/2 world, but the transition should be undertaken gradually and with care. Trying to change an entire company at once isn't necessary and will probably play havoc with your productivity. Files generated under OS/2 and DOS are compatible, so corporate planners will be able to mix and match systems to ensure an orderly transition. ■

Andrew M. Seybold is editor-in-chief of Andrew Seybold's Outlook on Professional Computing, a California-based newsletter.

TOM LEVITCH

A new cabin control system for Boeing's 747-400 jumbo jetliner uses all-digital technology to perform a wide range of passenger service functions previously unavailable. The Advanced Cabin Entertainment and Service System (ACCESS), designated the APAX-140, extends the application of digital multiplexed techniques to such functions as cabin interphone, lighting, and advisory signs. Other features include an interactive, two-way capability that allows passengers to communicate back to a central computer for in-flight ordering of specific goods and services, and a self-test function that monitors and records faults while in flight. Hughes Aircraft Company, supplying multiplexed passenger entertainment and service systems since 1970, designed and built ACCESS for Boeing.

A new advanced launch system (ALS) design for the U.S. Air Force will use off-the-shelf engines combined with modular configurations to reduce current launch costs. Hughes' ALS design will use a modified version of the Pratt & Whitney RL-10 liquid hydrogen/liquid oxygen rocket engine, with different numbers of modules tied together, depending on payload weight. The Department of Defense and NASA will require payloads ranging from 40,000-250,000 pounds to be placed in low Earth orbit. Aiding in cost reduction, the new design also features recovery of much of the booster. Hughes expects to meet the requirements for the ALS with its modular design by the mid-1990s.

A new software development tool significantly reduced fault locating time for the Hughes APG-70 radar aboard U.S. Air Force F-15E dual role fighters. Unlike previous systems requiring software check-out after the completion of hardware, the Hughes Digital Software Integration Station (DSIS) can test and de-bug software while the hardware is being built, resulting in substantial development cost and schedule savings. Further economies result from the radar's built-in test capability. It has ten times the software and six times as many test targets as its predecessor, the APG-63 radar. The APG-70's increased reliability and maintainability are expected to triple the time between unit replacements.

Millions of watts of electrical power can be controlled using an advanced electronic switch that can turn on and off at a rate of a million times a second. Developed under a Hughes research program, the CROSSATRON® modulator switch combines the features of thyatron and hard-vacuum thermionic devices. Promising a new generation of rugged, high-voltage switching devices, CROSSATRON employs a gas discharge for high closing currents and provides precise current interruption capability without a large forward drop. Expected applications include improving the performance of radar systems or other high-power tasks requiring repetitive openings and closings of large DC currents with assured reliability and long life.

A broad spectrum of technologies, many of which grew up within the past five years, are represented in the products of Hughes' Industrial Electronics Group. Six divisions and two subsidiaries, each operated like a small high-tech company but backed by resources of its multibillion-dollar parent, offer career benefits to qualified engineers and scientists. Advancing technologies such as microwave and millimeter-wave communications, silicon and GaAs solid-state circuitry, fiber optics, and image processing equipment are pursued in facilities located in many of Southern California's most desirable coastal communities. Send your resume to A.T. Moyer, Hughes Industrial Electronics Group, Dept. S2, P.O. Box 2999, Torrance, CA 90509. Equal opportunity employer. U.S. citizenship required.

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NTT Squanders a Lead

LOW DEMAND FOR SERVICES HURTS DIGITAL PLAN

■ By Robert Chapman Wood

IN LATE MARCH, Nippon Telegraph and Telephone (NTT) finally began offering customers its integrated-services digital network, climaxing more than 12 years of pioneering work on a telecommunications system that can carry many types of data. However, the products NTT introduced represent a major retreat from the ambitious schemes originally planned, and many observers—including NTT's own president—say the company's preoccupation with technological possibilities obscured market realities.

The worldwide telecommunications industry has been struggling for years to create a workable all-digital network. One digital line can carry such varied services as telephone, telex, high-speed facsimile, computer, and cable TV.

NTT was one of the first organizations to show interest in digital networks; it began to invest in the technology during the mid-1970s.

While U.S. phone companies were preoccupied with the impending breakup of AT&T, the Japanese company pushed ahead, eventually developing a vision it called the Information Network System. In fact, in the early 1980s, some observers predicted that the AT&T breakup would keep the United States out of the race to create digital networks.

Things didn't work out that way. As early as 1979, Dr. Yasusada Kitahara, NTT's senior executive vice president, had urged the International Telecommunications Union to accept NTT's system as a model for digital services. The visionary plan laid innovative services over a base set of standards being formulated by the Consultative Committee on International Telephony and Telegraphy (CCITT), another major international standards body. Japan joined the United States and European countries

in accepting the CCITT standards, dubbed the Integrated Services Digital Network (ISDN), as the foundation for all digital networks.

But NTT, the world's largest corporation in terms of assets, wanted its system to go beyond integrating existing services, as ISDN was designed to do. The company hoped its bundle of advanced services would stimulate so

got videophone and teleconferencing equipment, teletext, and videotex.

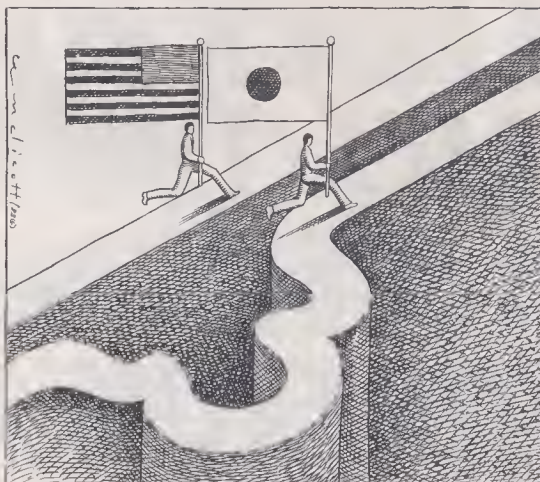
After an initial surge, system use sagged. User surveys showed interest in phones that gave the numbers of incoming calls, but little desire for home fax, videophones, or teletext. Consumers dismissed fax messages from government offices as junk mail that was doubly annoying because recipients had to pay for the paper. Videotex suffered from the same yawning indifference that has greeted videotex offerings in the United States.

NTT president Hisashi Shinto has not hidden his displeasure at the results of the Mitaka experiment. He has told the Japanese press that he thinks NTT engineers tried to make the public use products that had little value to them. Future research, he says, "should not be activities conducted for the benefit of engineers."

NTT gained some benefit from its early commitment to digital networks, because it started thinking about upgrading equipment for digital service earlier than did utilities in most other countries. However, Japan's level of interest in the technology has fallen far short of NTT's original hopes, and the system the company has finally deployed is closer to ISDN than to NTT's original concept.

Japan's digital experience points out that apparent challenges to U.S. technology are not automatically sure things. NTT's retreat has effectively wiped out a substantial early lead. Despite the upheaval in the U.S. telecommunications industry caused by deregulation and the breakup of the Bell telephone system, U.S. companies appear to have retained a key role in the future of telecommunications. ■

Robert Chapman Wood is an analyst and business consultant who specializes in technology and the Japanese economy.



much business that it could eliminate long-distance charges without raising local rates. Kitahara predicted that by 1995, NTT would be able to base its rates on the amount of information transmitted, not how far it was sent.

However, NTT's bold approach may have overestimated the market for such a system. While Western ISDN proposals moved ahead carefully, unsure of demand, NTT seems to have assumed that digital services would become part of daily life.

The company launched a major Information Network System experiment in 1982 in Mitaka, a Tokyo suburb. Consumers received medium- and high-speed facsimile machines linked to government agencies, offices, and friends, plus telephones that displayed phone numbers for incoming calls and charges for outgoing calls. The test group also



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Exports: Handle With Care

WARNING SIGNS SUGGEST POSSIBLE TROUBLE

■ By James A. Durham

A FORTUNE 500 company recently tried to sell a Chinese buyer technology for a copy system that doesn't use carbon paper. The company assumed this would be a routine matter not requiring an export license, and the U.S. regulations governing exports seemed to agree.

The Department of Defense, however, thought otherwise. It took the position that this seemingly innocuous technology could be adapted for use in military situations. Acquiring the necessary export license took several months and cost thousands of dollars.

The surprised company is just one of many organizations that have learned—painfully—that U.S. export regulations cover more than products traditionally considered militarily sensitive. And, despite continuing pressure to ease export restrictions, Toshiba's sale to the Soviets of advanced milling equipment for submarine propellers spurred Congress to draft stiff penalties for foreign companies that divert products to unauthorized destinations. Many observers worry that this could spark an export-control trade war, making exports even more cumbersome.

Export regulations also can affect domestic sales as well as the domestic and international transfer of information. The problem is especially acute for technology-oriented companies, because the vast majority of illegal exports involve high-technology items. For example, Digital Equipment Corp. incurred a \$1.5-million fine for selling equipment to a European businessman with known ties to the Soviet Union. More subtle and more common violations are usually handled privately through negotiations with the Office of Export Enforcement and do not find

their way into public records, even when sanctions are imposed.

According to export regulations, the government does not have to prove that a company intended to violate the rules. Companies can be found liable for fines if they "knew or should have known" that they were participating in any way in an illegal export transaction.

To help businesses avoid mistakes,

technical data may not be exported, or even released to foreign nationals within the United States, without an export license or a written assurance from the foreign recipient that the data (and the products based on the data) will not be re-exported to an unauthorized destination or individual.

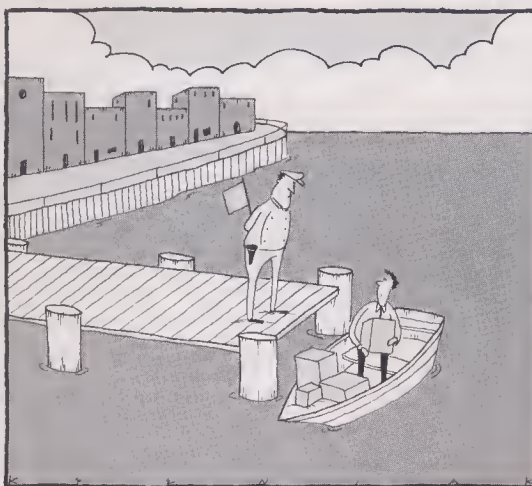
Violations of these regulations often occur when companies hire foreign employees or offer plant tours to foreigners. Even preliminary discussions between U.S. and foreign executives in anticipation of a joint venture or other deal can result in the release of technical data that requires an export license.

To avoid possible violations, companies must be sure to investigate all unusual orders. Before sharing technical information with foreign customers, visitors, or employees, a company must specifically determine whether or not it needs an export license or nondisclosure agreement.

Companies that know about violations of export regulations should consider reporting the situation to the Office of Export Enforcement. The office looks much more favorably on companies that voluntarily disclose violations than on cases in which the government discovers the infraction.

Finally, it's never safe to assume that a product is too "low tech" to be affected by export regulations. The Commodity Control List, which dictates licensing requirements for most products, is seriously outdated and includes a great deal of old technology and many products with no apparent military applications. Companies should audit their sales operations before something happens to cause the Office of Export Enforcement to audit them. ■

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the Department of Commerce has published a list of warning signs, commonly referred to as "red flags." These signs include unusual payment terms, delivery to an unknown entity, requests for special packaging (especially if the package must withstand exposure to salt water), or a failure to request warranty or service information. The presence of such conditions should cause a company to look more carefully at any business proposition. According to enforcement agent Scott Landry, if a company goes ahead with a sale despite the waving of a red flag, the Commerce Department may conclude that the company should have known it was involved in an illegal export transaction, and may prosecute the case.

Companies should be concerned about the transfer of information as well as products. Certain categories of

Rethinking Artificial Intelligence

Amid poor sales, some companies find hope in expert systems that abandon the ivory-tower approach

BY ALEX KOZLOV

MICROAMERICA, a company in Marlborough, Mass., that sells computer hardware, takes a lot of orders by telephone. Not long ago, if a customer called to order an item that happened to be out of stock, the operator could do little more than apologize. Then last year, MicroAmerica enlisted the help of artificial-intelligence programming built into the Tolas Telestream sales-support software it bought from GSI Transcom of Pittsburgh. Now, if an item is sold out, the computer is smart enough to give the operator alternatives to suggest to the caller. As a result, MicroAmerica is building a reputation for good customer service.

As success stories like this become more widespread, artificial intelligence (AI) software seems at last to be finding a home in business. But that doesn't mean business is good for the artificial-intelligence industry—at least not for the handful of companies that came roaring out of university research labs about five years ago with dreams of a new technology that would mimic human thought.

Their brand of AI—software systems that use esoteric computer languages and run on specialized, expensive computers—isn't selling well, and it's dragging the companies down. For example, AI pioneer Intellicorp Inc. posted a \$4-million loss for fiscal 1987. Shearson Lehman Hutton analyst Patricia Laupheimer expects the company to finish fiscal 1988 on June 30 with a \$35,000 loss. Teknowledge, a company

that helped found the AI industry, lost more than \$2 million in fiscal 1987, and Laupheimer expects the company to continue to bleed this year.

The companies showing greater promise include entrepreneurial ventures that take advantage of the fact that artificial intelligence is just software—albeit very advanced software.

In the hotly contested battle for the nascent commercial-AI market, low price and ease of use count for at least as much as technological superiority, and some newer companies are paying a lot of attention to what the market actually wants. "The real race is to see which companies will embed their technology inside products and services to do something useful," says Larry Geisel, president and founder of Intelligent Technology Group. "They will become known as successful solution companies, rather than as artificial-intelligence-technology companies."

Foremost among the solution-sellers are Aion, First Class Expert Systems, Gold Hill Computers, Intelligent Technology Group, and Neuron Data. Although these companies differ widely in their specific strategies, they generally are riding the market trend toward AI software that runs on standard computers—the personal, mini, and mainframe machines already used in thousands of businesses.





GEORGE STEINMETZ

Even though the AI pioneers are behind, they can't be written off. Several have adopted the strategy of writing software for common rather than specialized computers. They are also consolidating and restructuring their organizations, often laying off workers and streamlining to meet the changing market head on. Still, as these companies dig themselves out, their upstart rivals gain momentum.

The still-emerging technology of artificial intelligence comprises advanced computer systems that have more reasoning ability than ordinary computers and therefore can solve more complex problems. Almost all commercial AI today belongs to a group of relatively elementary products called expert systems—programs that mimic the decision-making process of an expert in a particular field. Software companies generally sell what's called an expert-system shell, which is a software skeleton that purchasers flesh out to create a program that fits their particular needs.



Neuron Data's Perez (left) and Rappaport prosper by selling AI software that runs on popular computers.

Such systems are proving useful in diverse industrial and business settings. For example, an inexperienced factory worker might consult an expert system instead of scratching his head over an equipment breakdown. Such down-to-earth uses of artificial intelligence are expected to spur sales. Market-analyst company Frost & Sullivan expects annual AI sales, including hardware, to reach \$1.7 billion by 1990, a fourfold increase over 1986 sales.

However, several drawbacks hindered the first generation of expert systems, which appeared only a few years ago. Customers had to buy expensive hardware, such as computers

from Symbolics of Concord, Mass. These computers typically required special AI programming languages, especially Lisp, which manipulates symbols rather than data. In theory, these machines are better suited to run AI software, but few businesses know enough about them to use them effectively. In addition, highly paid "knowledge engineers" (programmers who replicate an expert's skill in a computer) often spent months picking the brain of an expert in a given field. The result was expert systems that cost more than \$100,000, pricing many potential customers out of the market.

The newer, less expensive expert systems that run on standard computers are expected to account for much of the market growth. "More people are willing to pay, say, \$8,000 to see what AI can do," says Bahar Gidwani, an analyst with Kidder, Peabody. Some packages that run on personal computers cost less than \$1,000 and let companies develop their own AI programs without using expensive knowledge engineers. More advanced personal-computer and workstation packages that cost \$5,000 to \$10,000 compete against older, more expensive systems.

With their products well positioned, upstart companies such as Neuron Data seem to be stealing the show from established competitors such as Intellicorp and Teknowledge that take in as much as four times more revenue. The more established companies felt "that they were offering state-of-the-art technology, and if people knew what was good for them, they

would buy it, regardless of how much it cost," says Harvey Newquist, analyst and editor of *AI Trends*, a newsletter published by the market-research firm DM Data. "It took AI companies a while to find out that the market drives the technology, not vice versa."

The new AI players emphasize results, not technology. "We tend to not even use the term AI," says Aion president Harry Reinstein. "To say we're in the business of artificial intelligence is like Boeing saying it's in the business of building artificial birds."

"I asked myself, 'What does the business person need? What's the payoff?' These questions don't necessarily have much in common with theoretical questions of mind," says First Class Expert Systems president and founder William Hapgood, a former Raytheon engineer.

No AI upstart has gone as far as Intelligent Technology Group in its efforts to bring artificial intelligence into mainstream computing. Its president, Larry Geisel, left the same post at AI-pioneer Carnegie Group to start the company. Essentially, Geisel and cohorts abandoned the AI establishment, looking for a better way to integrate the technology into conventional data processing.

"We don't want to be part of the club because we think the club has been unsuccessful," says Christopher Locke, vice president of corporate communications. The company's goal is to establish itself first as a supplier of conventional data-processing services. At the same time, it is working on a set of expert-system development tools that will allow it to em-

WHAT IS ARTIFICIAL INTELLIGENCE?

The term "artificial intelligence" means different things to different people. Academics take the narrow view that true artificial intelligence (AI) seeks to develop computer models of human intelligence. Developers of business software are less dogmatic, and often inappropriately put the AI label on any product that may arguably be considered "smart," or possessed of an advanced level of computing power.

Ignoring such marketing hype, commercial AI products generally fall into one of three categories: expert systems, natural-language systems, and neural networks.

Expert systems are by far the most plentiful type of commercial AI program. They are also called rule-based systems because they follow a set of rules to reach conclusions. To create an expert system, a "knowledge engineer"—the AI programmer—interviews experts in a particular field and distills their knowledge into a series of if/then rules.

Following the rules, an expert system running on a personal computer,

workstation, or mainframe can analyze a problem and advise people on how to solve it. The idea is to make the experts' knowledge available to novices. For example, a financial-services system might tell an inexperienced loan officer, "If the loan applicant is \$40,000 in debt with an income of less than \$30,000, then he is a bad risk."

The knowledge represented in an expert system is restricted to a narrow field, ranging from the relatively mundane (how to fix a car engine) to the esoteric (deciding where to drill for oil). AI purists scoff at these systems, arguing that experts use a lot more than if/then reasoning when making decisions.

Natural-language programs come closer to representing human cognition. They grew out of AI research into how people derive meaning from language—how do we understand, for example, that a reference to New York in a sentence refers to the city or the state? Natural-language software consists of powerful programs that let people tap into a database using plain-English commands instead of

computer language. For example, Home Owners Warranty uses a system made by Artificial Intelligence of Waltham, Mass., that lets computer operators get information by asking the computer questions such as "How many builders in New Jersey have open claims?"

Other major suppliers of natural-language systems include Cognitive Systems of New Haven, Conn., Symantec of Cupertino, Calif., and Direct Aid of Boulder, Colo.

Neural networks, the most ambitious form of artificial intelligence to date, are still in the research lab, especially at Princeton and the California Institute of Technology. Developers aim to recreate in silicon the complex network of neural pathways in the brain to build a computer that would mimic human thought. The technology is promising, but a long way from commercial use. So far, researchers have simulated the nerve structure of the eye's retina and the ear's cochlea, and AT&T has created a computer copy of the brain of a garden slug. It's something to think about.

5 EMERGING CHAMPIONS

COMPANY	FOUNDED	OFFICERS	1987 REVENUES	AI PRODUCT(S)
 Aion 101 University Ave. Palo Alto, CA 94301 (415) 328-9595	1984	Harry Reinstein, president and CEO	Not available (privately held)	Aion Development System, for data-processing departments running management-information systems on IBM mainframes
 First Class Expert Systems 286 Boston Post Rd. Wayland, MA 01778 (617) 358-7722	1985	William Hapgood, president	Not available (privately held); profitable for the last two years	1st Class development systems based on personal computers
 Gold Hill Computers 26 Landsdowne St. Cambridge, MA 02139 (617) 621-3300	1984	Carl Wolf, president	\$8 million	A range of personal-computer-based tools for developing expert systems using the Lisp programming language
 Intelligent Technology Group 115 Evergreen Heights Dr. Pittsburgh, PA 15229 (412) 931-7600	1987	Lorry K. Geisel, president and CEO	\$6.6 million	Data-processing services for corporations; related expert systems under development
 Neuron Data 444 High St. Palo Alto, CA 94301 (415) 321-4488	1985	Patrick Perez, CEO; Alain Rappoport, president	\$4.5 million	Nexpert shell for Macintosh and IBM personal computers, DEC's VAX, and Sun, Apollo, and Hewlett-Packard workstations

bed expert systems within its data-processing software. Such an embedded system might provide credit authorization for banks, working with their main databases to easily access the account information to permit a credit-card purchase. Intelligent Technology is also developing expert systems that would work alone, and is creating text-management AI systems for personal computers.

One of the company's first moves was to acquire a data-processing division of Control Data. This gave Intelligent Technology instant access to a number of data-processing customers, including a federal agency and a New York financial institution—business that gave Intelligent Technology \$6.6 million in revenues and made it profitable during its first eight months. More importantly, its clients signed \$35 million in new contracts for data-processing services.

The company made a point of keeping customers comfortable by not abandoning conventional data-processing techniques. However, it is getting ready to enhance those techniques using its arsenal of expert-system development tools. "We won't try to force AI on customers," says Locke. "AI is only one tool. Where it's appropriate, we'll use it."

Other companies are concentrating on supplying AI software-development tools that can more readily be used by companies to build their own expert systems.

For example, in 1985 First Class Expert Systems Inc. (formerly Programs in Motion) released its first AI product, the 1st Class software shell that lets people design their own ex-

pert system on an IBM PC. The 1st Class shell costs only \$495. Last July, the company introduced a more powerful version, 1st Class Fusion, for \$1,295. By early 1988, the company had sold about 5,000 copies of 1st Class and about 400 copies of 1st Class Fusion.

"Our target is a guy in a big organization with his own problems," says Hapgood. For example, engineers at Du Pont's plant in Circleville, Ohio, used 1st Class to develop expert systems that help inexperienced workers monitor sophisticated plastic-molding equipment.

"There are certainly problems that require very large AI systems," says Hapgood. "But AI is still new, and a lot of people aren't sure what it means. 1st Class doesn't risk much money or time."

For problems that require more sophisticated solutions, Neuron Data offers a more expensive expert system, although the \$5,000 price is still comparatively affordable. Like 1st Class, the Nexpert system runs on computers that are already plentiful: the Apple Macintosh and the IBM PC/AT and PS/2. Neuron Data also sells \$8,000 versions for Digital Equipment's VAX minicomputers, as well as for Unix-based workstations from Sun, Apollo, and Hewlett-Packard. Nexpert is designed to compete with more complicated AI programs that cost as much as \$80,000. So far, the product has attracted an impressive list of customers, including Boeing, General Electric, Hughes

AI FUNDING IS RUNNING OUT

Like many other high-technology companies, those in the artificial-intelligence industry face a possible cash crisis as a result of last October's stock-market crash and the uncertain economy.

"The market is not too happy right now with the two publicly traded expert-systems companies, Intellicorp and Teknowledge," says Patricia Laupheimer, an analyst with Shearson Lehman Brothers. Both companies' stocks are rated only at the amount of cash each company has on hand. Such a climate "will probably make it more difficult for a privately held expert-system vendor to go public," she says.

Harvey Newquist, an analyst with DM Data, holds out little near-term hope for the entire industry. "First of all, venture-capital money for the new, emerging firms is almost dried

up, at least temporarily," he says. "Second, the public AI companies took a major hit in October, and until the market regains confidence in high-tech stocks in general, confidence in AI won't be restored." Even established firms will need creative ways to raise capital, he says, adding, "Some will have to go into major debt."

However, analyst Bahar Gidwani of Kidder, Peabody thinks the larger artificial-intelligence companies will remain somewhat attractive to investors, because such companies represent more certain investments. This may widen their lead over would-be competitors. "Because small companies don't have established records of revenue or profit, it will be difficult for them to get initial public offerings. Most venture capitalists with these small companies wish they were elsewhere," says Gidwani. "The older,

more established firms will grow stronger—age gives you size."

One bright note for companies that can afford to get products out is that the AI market is expected to grow despite the economic climate. Newquist thinks that most AI customers won't drastically cut back their AI purchases. "With costs coming down, customers will be able to get the same for less," he says. "Especially with the PC-based products, customers will be able to get more of their people acclimated to the technology without spending a lot of money." Indeed, an informal survey conducted last November by the AI company New Science Associates of Stamford, Conn., showed that its customers planned to expand spending on artificial intelligence by 84 percent this year. That could mean big money. The question is, for whom?

Aircraft, Merrill Lynch, and McDonnell Douglas.

Neuron Data reports 1987 earnings of more than \$2 million on \$4.5 million in sales. The company markets Nexpert throughout Europe, Asia, and Australia, and has distribution agreements with Hitachi, Digital Equipment, and Bechtel.

The role that Nexpert's simplicity and ease of use plays in winning customers cannot be underestimated. Chairman and chief executive Patrick Perez explains that Neuron Data's original aim of developing an AI system for Apple Macintosh computers forced the company to make the product accessible. "Early AI programmers worked in Lisp. They had no practical constraints. They had all the processing power they wanted, so they didn't have to worry," Perez says. "At Neuron Data, we knew we were going to put our system in a very small box. That gave us a big advantage."

Gold Hill Computers takes a similar approach to the AI market with its Goldworks expert-system shell, which sells for \$7,500 and runs on the IBM PC/AT, the PS/2, and Compaq Deskpro 386 personal computers. The package can be used with such popular software as Lotus 1-2-3 and Ashton-Tate's dBase. "If potential customers have \$100,000 to spend, they usually go to Intellicorp or Inference," says William Hoffman, director of marketing at Gold Hill. "If they only have \$20,000, we usually get them."

Gold Hill's attack on higher-priced expert shells is starting to pay off. The company's 1987 revenues were \$8 million, about three times what it took in the previous year. With more than 8,000 copies of Goldworks in use, the company says it has the largest base of users in the AI industry. Its system is distributed by Digital Equipment, Hewlett-Packard, Texas Instruments, Wang Laboratories, Data General, Intel, IBM, and Honeywell.

Despite its popularity, some critics complain that Gold-

works is not simple enough. A purchaser still needs programming help from a knowledge engineer to build an AI program, partly because Goldworks uses the Lisp language. Customers usually don't have their own Lisp programmers. Further, Lisp's storage demand means that Goldworks needs a personal computer with a hefty five megabytes of main memory, more than the average office machine provides. "Bringing Lisp to the personal computer is porting the problem, not the solution," says Locke of Intelligent Technology.



CEO Reinstein is placing Aion's expert systems in corporate data-processing departments, potentially a vast market.

DOUG MENUEZ

Although Aion's expert system is not made for personal computers, the product might be considered a more populist approach than Gold Hill's Lisp system. The Aion Development System works with standard IBM mainframes and uses conventional computer languages. This offers Aion the vast potential market also being eyed by Intelligent Technology: the corporate data-processing and management-information-system departments that rely on mainframes for everything from a company's payroll, billing, and inventory tracking to customer orders.

"Data-processing/management-information systems represent 70 to 80 percent of all computer purchases," says DM Data's Newquist. "If expert systems are going to be a big deal, they will have to be incorporated into mainstream management-information systems."

But corporate data-processing managers remain skeptical of AI. "They don't want anything to do with this black magic," says Newquist. Products such as the Aion Development System may help break down the resistance. "Data-processing/management-information-system people don't buy technology—they buy solutions. That seems to be a simple point, but it is often overlooked," says Aion's Reinstein.

Aion founders Reinstein and Lawrence Cohn—who each spent 23 years at IBM—realized that a new company would scare off many cautious data-processing managers, no matter how good its technology was. To prevent that, Aion lets established suppliers of data-processing services sell its AI-development product. Aion has agreements with McCormack & Dodge, Management Science America, Boole & Babbage, and Arthur Andersen, which all provide data-processing services. Aion also sells directly to *Fortune* 500 companies, but the agreements allow the partners to create customized AI programs for their customers.

For example, Boole & Babbage used Aion's product to create a system that monitors Boole's disk-drive analyzer; the system helps Boole customers find and fix problems before they lead to catastrophe. Aion systems are used in more than 80 corporate data-processing departments.

"Our strategy has been to be a product company, and develop relationships with service professionals to introduce the technology," says Reinstein. "This lets us focus on developing our product—a good focus for a young company."

Responding to the challenge posed by these upstart entrepreneurs, established AI companies are rapidly changing strategies. "Companies must integrate their systems with existing computers," says Newquist. "Telling customers they have to buy more hardware is not going to work."

The question is, can the established artificial-intelligence companies—especially the so-called Gang of Four, Carnegie Group, Inference, Intellicorp, and Teknowledge—still save themselves?

Generally, the AI companies defend their former ivory-tower approach to the technology and its potential market. "Part of the reason we were not that profit-oriented is because we had to invest in developing the technology," says Inference president and chief executive Alex Jacobson. He argues that artificial intelligence, like other emerging technologies, followed the customary pattern of being promoted by excessive hype, followed by inevitable disenchantment. He says the technology is now reaching the next stage of this process, when people return to it with more realistic expecta-



MALYSZKO



Gold Hill president Carl Wolf saw revenues triple last year, as the Goldworks expert-system shell became the most popular AI tool in the business.

tions; that explains the emergence of AI upstart companies.

But Jacobson maintains that established AI firms are also factors in the growing commercial market. "All of us are struggling to extend into marketing," he says. "There are companies that aren't responsive enough, but I hope mine isn't one."

According to Newquist, Los Angeles' Inference responded well to the need to make systems available on standard computers. In addition to its move into products based on personal computers, in January Inference announced the formation of a consortium with Ford Motor Company and Lockheed, two users of its Automated Reasoning Tool expert-system shell. The agreement calls for developing expert systems that run on existing IBM data-processing computers. "Management-information systems is *the* major market," affirms Jacobson.

In contrast, Intellicorp of Mountain View, Calif., stayed with its Lisp-based systems longer, and is now trying to catch even Inference, says Newquist.

Last July, Intellicorp restructured itself to become more responsive to the demands of the AI market. The company cut its work force by about 10 percent, then sharpened its focus on developing AI software to run on general-purpose computers. Intellicorp also plans to integrate its products more with conventional programming languages and common databases, and to target the information-access and manufacturing markets.

Also, in February the company introduced a \$10,000 version of its Knowledge Engineering Environment (KEE) expert-system shell made for 80386-based personal computers. KEE is Intellicorp's flagship product, originally introduced as a \$55,000 system for very complicated uses that ran only on specialized hardware. "The expert-system market originally was made up of large companies with large budgets doing

CASE HISTORIES: A HIT AND A MISS

AN EXPERT SYSTEM THAT WORKS

Chemical Bank's development of a successful expert system can be attributed to the company's realistic expectations, careful planning, and solid management support. "They chose a small problem, worked around connectivity issues, and made the system easy to use," says Michael Schneider, a technology analyst for Gartner Group.

The system, called Auditing Assistant, works in Chemical's \$750-billion foreign-exchange trading department, checking for irregular trading patterns that could indicate improprieties such as embezzlement or kickbacks. The system improves auditing speed and quality because it scans 30 times more data than a human can, according to Craig Atkinson, Chemical Bank vice president of advanced technology.

The New York bank created its Advanced Technology Department in May 1986. Within six months, the department had acquired a Lisp proces-

sor from Symbolics and the Automated Reasoning Tool expert-system shell from Inference Corp. Chemical decided to develop a system for foreign-exchange trade auditing because it was assured support from upper management. "The vice president in charge of auditing was a friend to technology, his department had some extra money, and he had a specific business problem," says Atkinson.

The trading volume in the foreign-exchange department had increased about 70 percent in the preceding three years, and represented a significant revenue source. Any improvements could have a dramatic impact on the bottom line.

After four months of development, with help from Inference, the \$175,000 system was in operation and the bank had plans for expanding the project's scope. Gartner's Schneider says the project succeeded because the bank kept it tightly focused.

"We recognized up front that we didn't want to take on the whole world-wide-exchange trading environment,"

Atkinson says; at first, the system checked New York-based trades in dollars and pounds only. But the system's flexibility let Chemical recently add deutschemarks and yen, and the bank plans to expand the system to include London-based trades.

By designing the system to run independently, Atkinson circumvented the compatibility problems that sometimes cripple expert systems that must be connected to other computers. To transfer data between desktop terminals and the expert system, a person stores information on tape and carries it between machines. "I did not want to deal with connectivity problems," Atkinson says.

Finally, Atkinson's group spent almost half its development time working with auditors to create software that was easy to use and compatible with their work habits. The auditors were happy to help build a system that would ease mounting workloads, and because the system was designed only as an assistant, it posed no threat to their jobs.

large exploratory efforts," says Thomas Kehler, Intellicorp president and chief executive. "KEE got a big part of that market." Intellicorp says it has installed 1,800 of the systems at 500 data-processing centers. However, this hasn't pushed the company to prosperity; last year Intellicorp posted a \$4-million loss on sales of \$20.4 million. Founded in 1980, Intellicorp is the largest AI company, and among the oldest.

Intellicorp's marketing strategy in the personal-computer-based AI market is to emphasize its experience and expertise in high-cost expert systems. In addition, the company also touts its full line of expert-system shells, from simple, low-cost programs to complex, expensive versions. "We make it possible for people to get started with lower budgets, but we also offer customers the ability to move upward" to more advanced systems, says Kehler. "We can take our customers from start to finish."

However, industry observers remain skeptical. Newquist notes that, despite its success selling high-end expert systems, Intellicorp is unknown among the new customers for low-cost artificial intelligence. And analyst Gidwani doesn't expect customers to go for the plan to start them small and work up into more advanced systems. Businesses want something that works today; they're not planning long-term AI strategies, he says.

Carnegie Group's strategy is to emphasize marketing. The Pittsburgh company came from a university environment, says newly appointed president and chief executive Dennis Yablonsky. "There was little marketing, sales, or business experience. That is typical for a new industry, but now the in-



William Hapgood, president of First Class Expert Systems, expects customers to go for easy-to-use artificial-intelligence products offered at bargain-basement prices.

AN EXPERT SYSTEM THAT FAILED

Just before its 1984 merger with Lehman Brothers, Shearson American Express developed an expert system that reportedly earned \$1 million in just two months. Within a year, however, both the system and the senior vice president who developed it were gone. Today Shearson's experience is a telling example of how mismanagement and lack of commitment can scuttle an artificial-intelligence project.

The K:Base system was designed to match up major borrowers who might want to exchange interest rates. This process, known as interest-rate swapping, can mean fees of nearly \$1 million for the investment bank that brokers the deal. K:Base was supposed to help traders sift through masses of data to quickly identify likely swap candidates among institutions from around the world.

Largely because management support for the project dissolved, K:Base never completed the odyssey from laboratory to Wall Street. In March 1984, Shearson senior vice president Bruce Gras approached Brattle Research of

Cambridge, Mass., about an interest-rate-swapping expert system. Brattle wanted to develop the system on a Symbolics computer using the Lisp computer language, one of the fastest ways to develop expert-system software. But at the time, Lisp machines cost as much as \$100,000.

To limit costs, Gras went to Gold Hill Computers to develop a K:Base prototype on a personal computer that could eventually be linked to a Lisp machine. By August he had a crude prototype. However, the personal-computer version of K:Base worked about 30 times slower than a Lisp processor would have, making it useless on Wall Street, Gras says. The Lisp version never got out of Gold Hill's laboratory. Gras himself soon left Shearson Lehman to work for Symbolics; about a year later, he left Symbolics for health reasons. Currently, he works for the consulting firm of Arthur D. Little Inc. in Cambridge, Mass.

What happened to K:Base? Peter Hollings, president of Integrated Analytics in New York, hypothesizes that it vanished because it lacked support. "Interest-rate swapping is a database problem," he says, "and the data is in

the heads of highly paid people who are valuable because of what they know." K:Base required traders to enter information, thereby sharing leads with the rest of the company.

If that wasn't bad enough, after the merger Lehman Brothers took charge of the interest-rate swapping department. "I was swimming against the tide," Gras says, because Lehman had a different swapping strategy that made an expert system less necessary.

Expense was another issue. Despite efforts to reduce costs, Gras estimates that the prototype cost about \$100,000 to develop. The planned addition of two Lisp machines could have added another \$140,000, plus \$1,500 a month for service. Shearson Lehman executives may have had little inclination to gamble on an expensive new technology when they had their hands full consummating a merger.

Other experts claim that Gras' departure contributed to the system's downfall, saying that any new technology requires a mentor. "The system was like an orphan; when the parent left, no one adopted it," says a Shearson Lehman Hutton executive.

—Randy Ross

dustry is making a transition. Whichever company does it fastest will have an edge," he says. To rapidly build a marketing organization, Yablonsky is bringing in people with more marketing and sales experience.

However, the company will continue to develop high-end, custom AI systems rather than inexpensive tools for the mass market. "Our focus is on manufacturing and engineering problems," says Yablonsky. "We use off-the-shelf hardware like Sun workstations and Digital's MicroVAX, and tailor software. We want to have a relatively few large, stable, and long-term customers."

Similarly, Teknowledge of Palo Alto, Calif., has opted to stay with high-cost, custom AI systems and services, after an abortive year-long effort to sell its Copernicus expert-system shell for personal computers. In February, Teknowledge said it was abandoning Copernicus and laying off 60 employees.

A problem with this strategy, however, is that Teknowledge's service business is falling off, says Shearson Lehman's Laupheimer. General Motors—Teknowledge's biggest customer, contributing \$5.2 million to its \$25-million revenues in fiscal 1987—is slowing its spending in AI. This leaves Teknowledge's fate uncertain.

As these old-guard AI companies do battle in the changing expert-system market, they face another threat: mainline software suppliers entering the AI arena. Companies such as Ashton-Tate, Computer Associates, Lotus Development, Microsoft, and Oracle see expert-system technology as a way to

enhance existing products. Many software makers are expected to get into AI by acquiring companies. Other potential purchasers include hardware suppliers such as IBM, Digital Equipment, Sun Microsystems, and Texas Instruments (which already offers AI products). Eventually, says Laupheimer, "expert systems will no longer be a distinct market. Rather, they will be a technology available to software and systems houses and will become part of their products."

Signaling the start of this trend are moves such as last year's purchase of Level Five Research of Melbourne, Fla., by Information Builders, a 13-year-old database-management software company in New York. Already, Information Builders offers Level Five artificial-intelligence products integrated into its software.

"Small companies that have the technology but lack good business sense will probably be bought out, or flop," predicts Newquist. "Look for larger software companies not currently well known in AI—such as Cullinet, McCormack & Dodge, and MSA—to acquire smaller AI companies that have an iffy balance between technology and marketing."

Thus, just as artificial intelligence begins to work its way into business markets, the industry is due for a battle that pits old companies against new ones, and both against outside software suppliers. "By mid-1989," says Newquist, "we should have a good idea of who is beating who to the punch, and who will be victorious." ■

Alex Kozlov has written on technology for Science Digest and Discover magazines.

Business TV Becomes Big Business

Communications giants get into the act as television becomes the corporate newsletter of the 1990s

BY HERB BRODY

FEDERAL EXPRESS built its business on speed and efficiency, but the first thing its couriers do when they go to work is watch television.

A contradiction? Not really. They're watching a program on a private television network that tells drivers how the delivery system fared through the night—warning them, for example, when parcels from a particular region might be delayed. Federal Express says well-informed drivers handle customer questions and problems more efficiently, and thus give the company a critical edge in the highly competitive overnight-delivery business.

At company after company, television is moving from the employee lounge to the conference room. Corporate-owned private networks are becoming a potent business tool used to train employees, detail new products to salespeople in far-flung locations, and generally make workers feel more a part of their organization. In some companies, business TV acts as an electronic company newsletter.

So far, much of the business-TV market has been in the hands of the small companies that pioneered the field, Private Satellite Network (PSN) and VideoStar Connections. These outfits install and maintain satellite receivers

("earth stations") at facilities across the country; they lease the "uplink" that beams signals for programs from the ground to the orbiting satellite, and they broker satellite time for corporate clients. But as the growth of business TV brings in new competitors, including telecommunications giants such as AT&T and GTE, these pioneers can expect to see their market share erode.

The private-TV concept hatched only five years ago, when Hewlett-Packard installed satellite receivers at 50 field offices to distribute product information. By the end of last year, about 40 companies had set up private video networks that together reached more than 6,000 sites, according to Susan Irwin, a leading business-TV consultant. Multi-company networks that serve entire industries are bringing programming to thousands more locations, including hospitals, universities, and auto dealers. All told, business TV reaches 11,700 sites, says Irwin.

Both PSN and VideoStar claim profitability. PSN says it has sustained 30 to 40 percent growth each year since entering the business in 1984. But VideoStar is getting most of the new business, according to industry analyst Elliot M. Gold, editor and publisher of *Business TV* magazine. At least two long-standing PSN customers—Digital

Equipment Corp. and Aetna Life & Casualty—have switched to VideoStar.

The two business-TV pioneers follow contrasting strategies. PSN aims to hook customers with the prospect of regularly scheduled programming. But setting up a permanent network can be expensive. A network of 50 sites requires an investment of about \$1.1 million to \$1.3 million, according to marketing consultant Suzanne Detlefs. About half of that pays for the central uplink; the balance covers receiving stations and access to satellites. A programming studio adds another million.

VideoStar typically tries to win a new customer by producing a program on a special event, such as a new-product launch. Once a company tastes the benefits of business TV, it presumably will more readily buy a permanent network. In addition to luring customers, such special-events productions are profitable in themselves.

PSN and VideoStar now face strong challenges to their dominance. Indeed, the biggest plum recently held out by business TV was snatched by a relative newcomer, Satellite Conference Network (SCN). SCN is installing receiving stations at 1,200 offices of the A.L. Williams Insurance Company. These sites will get about two hours of specialized programming every business day, in-



BENNO FRIEDMAN

PSN president Richard Verne faces tough competition from long-standing rival VideoStar as well as newcomers to business TV.

cluding management and customer training, new-product information, and company news, says SCN president Reza Jafari.

But the companies in the best position to profit from the growth in business TV are satellite-communications generalists, especially AT&T, Contel/ASC, GTE Spacenet, and Bonneville Satellite. Such companies operate their own for-hire satellites and thus have more control over a network than the specialists, who must themselves lease satellite time for their clients. Also, because the generalists offer direct satellite connection, they can charge less for their services.

Satellite owners carry various other strengths into the business-TV battle

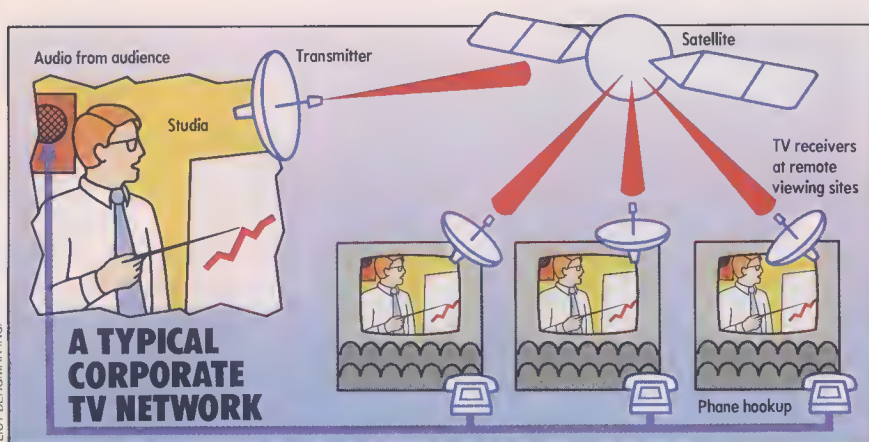
as well. AT&T offers the credibility and service support that only an institution can. Bonneville Satellite is a partnership between Simmons Satellite Ltd. and Bonneville International; the latter is wholly owned by the Mormon Church. The Mormons are buying a business-TV network from Bonneville Satellite that will ultimately reach about 2,000 sites. Contel offers a unique system that lets some receiving sites transmit their own video signals; other private networks typically allow program transmission from only one place, usually a company's headquarters. Sears recently signed a \$12-million contract with Contel/ASC to equip 800 stores and 26 regional offices with satellite equipment, making Contel a re-

spectable contender in business TV.

But probably the most significant advantage belongs to GTE Spacenet. It owns far more satellite capacity than its competitors; PSN and VideoStar both buy satellite time from Spacenet, says Irwin. Also, Spacenet has successfully marketed an extensive satellite-based data-communications network. Companies on such a network could use it as a springboard into business television.

In fact, the biggest growth in business television will probably come from adding TV signals to a communications system already set up for other uses. "The incremental cost is modest," says Spacenet president C.J. Whalen.

GTE Spacenet in particular is posi-



tioning business TV as an extension of existing services. The company has installed receivers at 1,000 sites to provide data communications. Now, Whalen says, Spacenet guarantees those customers access to satellite transponders for television as well.

"Spacenet is our most credible competitor," acknowledges David Green, VideoStar's vice president for sales and marketing. In response to the growing threat, PSN and VideoStar are maintaining aggressive strategies in the hope that overall market expansion will cover any loss in market share. One way for a video specialist to ride out the new wave of competitors is to team up with one of them. "I think we'll see joint ventures between data-network companies and video-only providers," says VideoStar president Ken Leddick.

The business-TV industry remains an adolescent. Although the concept has been theoretically possible for as long as there have been satellites, private networks became much more economically viable with the advent of smaller satellite receiving stations. These very-small-aperture terminals (VSATs) have dishes that measure six to eight feet across, and cost only about \$5,000 installed. Occasional use of a satellite transponder to communicate with a VSAT costs about \$500 per hour.

Unlike commercial television, business TV permits viewer interaction. The video hookup works with a conventional telephone link, so viewers can talk back to the program. As a result, private networks are especially useful for training. "Our best instructor reaches 500 people at a whack instead of just the 25 who can fit into a room," says Rebecca Warshawsky, manager of Digital Equipment's business video network. This can be a particular mon-

ey-saver for large companies that regularly fly employees to central training centers, and also for retail-store chains, whose buyers can use the system to view merchandise and place orders.

Business TV also can hasten the spread of productive ideas. For example, when Eastman Kodak recently began shipping a new photocopying machine, customers discovered a problem in the photosensitive drum. At first, Kodak service people repaired the machines by replacing the \$700 drum.

Then Kodak developed a \$50 fix, and spread the word to its 500 field representatives immediately by broadcasting a two-hour presentation that included a question-and-answer session. Fast implementation of the cheaper repair saved Kodak \$350,000 over a period of nine months, says Gwen Kelly, a business-TV consultant who helped Kodak put its system together.

Such rapid communication of valuable ideas drove Domino's Pizza to set up an innovative business-TV system through VideoStar. Domino's video network links 32 regional dough-making plants with a truck-mounted transmitter that can broadcast from any plant. This lets various plants share innovations, says Jeffrey DeGraff, communications director for the fast-food chain. Within the next three years, says DeGraff, Domino's will expand its television network into some of its 4,255 pizza parlors.

Merrill Lynch has done one of the few studies on the dollar value of business TV. Three years ago, the brokerage house began satellite broadcasts to 15 of its sales offices, showing programs on new products such as mutual funds.



VideoStar's Leddick (seated) and Green may seek a partnership with a large communications firm.

THE 20 BIGGEST BUSINESS-TV NETWORKS

	ORGANIZATION	SUPPLIER	NUMBER OF SITES	USES
1	Church of Jesus Christ of Latter-Day Saints (Mormons) Salt Lake City	Bonneville Satellite	1,600 (400 under construction)	Personnel training
2	A.L. Williams Insurance Duluth, Georgia	Satellite Conference Network	1,000 (250 under construction)	Personnel and customer training, product introductions, employee news
3	General Motors Detroit	Electronic Data Systems	800 installed (400 planned)	Personnel training, employee news
4	Merrill Lynch New York	Private Satellite Network	470 (4 under construction)	Personnel and customer training, product introductions, employee news, press conferences, outside-vendor product information
5	Federal Express Memphis, Tennessee	Videostar	400	Personnel training, product introductions, daily news
6	Voluntary Hospitals of America Irving, Texas	Bonneville Satellite	337 (450 planned)	Personnel training, continuing education, employee news
7	IBM Armonk, New York	Private Satellite Network	225	Personnel and customer training, product introductions, employee news
8	Ford Motor Dearborn, Michigan	Private Satellite Network	213 (22 under construction)	Personnel training, product introductions, employee news, press conferences
9	J.C. Penney New York	Private Satellite Network	210 (430 under construction)	Personnel training, product introductions, outside-vendor product information
10	Southeast Toyota Ocoee, Florida	Automotive Satellite Television Network	146 (10 under construction)	Personnel training, employee news
11	IDS Financial Services Minneapolis	VideaStar	145 (46 under construction)	Personnel and customer training, product introductions, employee news, press conferences
12	Gulf States Toyota Houston	Automotive Satellite Television Network	110	Personnel training, employee communications
13	AT&T Bedminster, New Jersey	AT&T	100 (100 under construction)	Personnel and customer training, continuing education, product introductions, employee news, press conferences
14	Hewlett-Packard Palo Alto, California	Videostar	96	Personnel training, product introductions, employee news, continuing education
15	National Rural Electric Cooperative Association Washington, D.C.	Internal	92 (167 under construction)	Personnel training
16	Mid-Atlantic Toyota Glen Burnie, Maryland	Automotive Satellite Television Network	90	Personnel training, employee communications
17	Digital Equipment Maynard, Massachusetts	VideaStar	85 (15 under construction)	Personnel and customer training, product introductions, press conferences
18	Computerland Oakland, California	VideaStar	80 (20 under construction)	Personnel and customer training, product introductions, employee news, press conferences, product information from suppliers
19	K Mart Troy, Michigan	GTE Spacenet	250 under construction	Personnel training, product introductions, employee news, press conferences, outside-vendor product information
20	Sears Chicago	Contel/ASC	800 planned	Product introductions

SOURCE: BUSINESS TELEVISION DIRECTORY (IRWIN COMMUNICATIONS AND TELEHEALTH ASSOCIATES)

BUSINESS-TV PLAYERS

COMPANY	REVENUES	NETWORKS	SITES	MAJOR CUSTOMERS	STRATEGY
Bonneville Satellite Communications 19 W. South Temple Salt Lake City, UT 84101 (801) 322-4400	Not disclosed	5	3,700	Mormon Church, Hospital Satellite Network, Help-U-Sell (a real-estate sales franchise)	Most systems at Mormon church centers and in hospitals; also a major provider of satellite services for syndicated TV.
Contel/ASC 1801 Research Blvd. Rockville, MD 20850 (301) 251-8333	Not disclosed	1	800 (planned)	Sears	Uses promise of business TV to help sell satellite networks for data communications.
GTE Spacenet 1700 Old Meadow Rd. McLean, VA 22102 (703) 848-1000	Not disclosed	1	150	K Mart	Sells business TV as an enhancement to customers of satellite data networks.
Private Satellite Network 215 Lexington Ave. New York, NY 10016 (212) 696-9476	More than \$20 million	16	More than 1,800	Ford, IBM, Merrill Lynch, J.C. Penney	A business-TV specialist that focuses on building permanent networks; has been losing market share to VideoStar and others.
Satellite Conference Network 708 Third Ave. New York, NY 10017 (212) 351-2700	Not disclosed	5	1,567	A.L. Williams Insurance, Illinois and Georgia bank associations, the CPA Network (for certified public accountants)	Targets the financial-services industry.
VideoStar Connections 3390 Peachtree Blvd. Atlanta, GA 30326 (404) 262-1555	More than \$22 million (FY ending 6/30/88)	14	1,108 (1,788 by year's end)	Allen Bradley, Chrysler Motors, Computerland, Federal Express, Hewlett-Packard	A business-TV specialist; emphasizes special-events programming rather than permanent networks.

SOURCE: HIGH TECHNOLOGY BUSINESS RESEARCH

The company found that new products sold 30 to 40 percent better at offices connected to the network, presumably because their staff had better information. Now, 475 sales offices are hooked up, according to Marilyn Reed, vice president and manager of Merrill Lynch Video Services—90 percent of all the company's sales offices. "Potential users now can justify the investment in a TV network with the promise of hard dollar savings," says PSN president Richard Verne.

However, many uses of business TV defy straightforward cost/benefit analysis. Federal Express, for instance, will use its network to solicit ideas from its 4,000 branch managers. Suggestions are expected to contribute directly to the bottom line, but "it takes a leap of faith," says Tom Martin, managing director for employee communications.

But no company has gone as far as Ford in using TV for internal communications. The company distributes programming to 214 locations and intends to expand the network into each of its 250 plants and sales offices.

The automaker believes that it profits by keeping its 382,000 employees

better informed, explains Jack Caldwell, director of internal communications. The network carries a weekly news show and a monthly feature segment, as well as special events. The network showed live coverage of the funeral of Henry Ford II, and also the presentation of the 1987 *Motor Trend* Car of the Year award for the turbo-charged Thunderbird.

Some of the most successful business-TV networks cut across company lines. Among the most prominent are Automotive Satellite Television Network (ASTN), the Food Business Network (FSN), and Hospital Satellite Network (HSN). The organizations that run these networks specialize not in satellite-communications technology but in the production of industry-specific programming. Los Angeles-based HSN, for example, provides a variety of programs to both staff and patients at about 850 hospitals.

ASTN, a subsidiary of Dallas-based Westcott Communications, provides 40 hours of programming each month to about 3,000 car dealers. Among other things, the shows help train salespeople; dealerships have high turnover and

spend inordinate amounts of time breaking in new talent. ASTN charges \$385 per month for a subscription and is "very profitable," says president Tim Harrington. This success has attracted investment from the auto industry: General Motors subsidiary Electronic Data Systems recently bought 30 percent of the network, which reaches about 1,200 GM dealers.

Profits in the auto industry have enticed ASTN to expand. This spring, the company will roll out a business-TV system aimed at another industry—probably banking, real estate, or financial services. The company also may extend its service beyond video. "We can easily upgrade to two-way data communications," says Harrington.

The latest addition to the business-TV pantheon is Food Business Network (FSN), operated by Medialink of Pasadena, Calif. Launched last November, FSN carries news and feature programs to about 40 companies in the \$300-billion food growing and processing industries. Within two years, FSN should reach 1,500 subscribers, says Thomas Rasmussen, senior vice president at Medialink. Currently, the network's 45-minute-per-weekday doses of information originate at FSN. But to boost revenues, the network plans to carry product features from individual companies, says Rasmussen.

As a result of the growing popularity of both company-owned and industry-wide networks, the number of locations receiving business-TV broadcasts has been roughly doubling every year, says consultant Gold. Because of its high cost and often unmeasurable benefits, however, the technology remains primarily a tool of big companies. Of course, small outfits without money to splurge on corporate broadcasting seldom have offices and factories strewn coast to coast.

Another obstacle to wider use of corporate broadcasting is a lack of video production experience. After 40 years of exposure to network television, most viewers expect high quality from people on screen. An executive who projects charisma in the boardroom may look hopelessly amateurish to an audience whose standard of performance is Tom Brokaw. "We don't know yet how much stage fright there is out there among American executives," says GTE Spacenet president Whalen, "but I suspect there won't be a big problem. Most of us have pretty big egos." ■



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LEADING 100

COMPANY (SYMBOL/EXCHANGE)	RANK THIS MONTH/ LAST MONTH	PRICE INCREASE LAST MONTH (%)	CLOSING PRICE (\$)	EARNINGS PER SHARE		LATEST DIVIDEND (\$)	P/E RATIO	DEBT/ EQUITY RATIO	LATEST 12 MONTHS' REVENUE (IN MILLIONS)
				LAST QUARTER (\$)	CHANGE FROM 1 YEAR AGO				
AEROSPACE									
Ronson (RONC/NASDAQ)	1/32	41.3	1.06	.02	-86.7	—	NE	2.84	31.1
Hexcel (NXL/NYSE)	2/28	26.1	44.75	.90	36.4	.60	15.6	.87	349.2
Kaman (KAMNA/NASDAQ)	3/30	25.5	16.00	.36	20.0	.40	11.7	.55	707.5
AAR (AIR/NYSE)	4/23	21.6	22.50	.31	24.0	.36	19.9	.09	311.1
Sundstrand (SNS/NYSE)	5/22	17.9	52.75	-.55	NE	1.80	NE	.49	1,365.5
Lockheed (LK/NYSE)	6/14	16.3	44.50	2.08	24.6	1.40	6.9	.67	11,321.0
Trans Technol (TT/NYSE)	7/16	15.2	21.88	.61	-18.7	.88	9.4	.72	207.5
Cade Ind. (CADE/NASDAQ)	8/11	13.6	1.00	.02	-66.7	—	12.5	.62	55.1
Sierrocin (SER/AMEX)	9/5	12.6	5.63	.20	42.9	—	15.6	.38	73.5
Fairchild Ind. (FEN/NYSE)	10/31	11.9	9.38	-.13	NE	.20	NE	4.49	453.8
CHEMICALS									
Koppers (KOP/NYSE)	1/50	70.3	53.63	-1.51	-100.0	1.20	NM	.25	1,515.7
Ausimont Comp. (AUS/NYSE)	2/5	58.3	24.75	.35	6.1	.60	13.8	.25	730.5
Intl. Genetic (IGBI/NASDAQ)	3/3	46.0	4.38	-.08	NE	—	NE	.00	1.9
Aristech/Chem. (ARS/NYSE)	4/74	37.9	32.75	.84	95.3	.80	12.1	.19	918.8
Liquid Air (LANA/NASDAQ)	5/11	37.5	35.75	.70	18.6	1.60	13.9	.72	562.2
Nuclear Metals (NUCM/NASDAQ)	6/12	34.8	15.50	.03	-87.0	—	NE	.24	41.7
Huntington (NRCLY/NASDAQ)	7/35	34.2	20.13	.51	155.0	—	15.0	.27	71.6
Genex (GNEX/NASDAQ)	8/26	34.0	1.34	.13	NE	—	NE	.07	1.6
Flamemaster (FAME/NASDAQ)	9/64	29.1	2.75	.01	-80.0	—	9.8	.00	5.1
IMC Fertilizer (IFL/NYSE)	NC	28.8	31.88	NA	NA	.14	NA	NA	NA
COMMUNICATIONS									
Optelecom (OPTC/OTC)	1/58	73.4	1.63	-.04	NE	—	NE	.00	3.5
IDB Comm. Grp. (IDBX/NASDAQ)	2/68	39.5	9.25	.12	71.4	—	28.0	.78	9.6
Phonemate (PNMT/NASDAQ)	3/11	34.2	3.69	.11	.0	—	10.0	13.00	112.6
ACC (ACCC/NASDAQ)	4/64	30.4	1.63	.24	1100.0	—	14.8	.53	34.1
Elcotel (ETEL/NASDAQ)	5/69	28.3	5.13	.15	15.4	—	8.7	.00	21.5
C TEC (CTEXB/DTC)	6/34	27.2	32.75	NA	NA	—	NA	NA	NA
Westn. Union (WU/NYSE)	7/28	26.0	3.63	-.15	NE	—	NE	.27	824.5
ALC Comm. (ALCC/NASDAQ)	8/3	25.0	2.50	NC	NC	—	NE	2.39	NC
TeleQuest (TELQ/NASDAQ)	9/66	22.1	1.38	-.31	-100.0	—	NE	.01	26.0
CTEC (CTEX/NASDAQ)	10/38	21.8	33.50	.59	321.4	.92	15.0	1.33	133.8
COMPUTERS									
Priom (PRIA/NASDAQ)	1/182	75.3	2.63	.02	NE	—	NE	.10	137.1
Miniscribe (MINY/NASDAQ)	2/181	59.6	11.38	.16	60.0	—	15.4	.36	362.5
Dataflex (DFLX/NASDAQ)	3/151	59.3	4.38	-.08	-100.0	—	25.7	.29	19.3
Convex Comp. (CNVX/NASDAQ)	4/173	58.4	10.50	.08	14.3	—	33.9	.08	69.6
Britton Lee (BLI/NASDAQ)	5/52	54.3	2.13	-.87	-100.0	—	NE	.01	25.7
Apogee Robot. (APGED/NASDAQ)	6/94	53.2	1.44	.00	NE	—	NE	.00	2.9
Fingermatrix (FINX/NASDAQ)	7/54	53.2	2.88	-.12	NE	—	NE	.00	.2
C Cor Elec. (CCBL/NASDAQ)	8/69	53.1	9.00	.21	162.5	—	15.0	.44	30.8
Systems Integ. (SINT/NYSE)	9/62	52.6	7.25	.13	-18.8	1.20	23.4	.00	57.9
Ungermann Bass (UNGR/NASDAQ)	10/46	50.7	12.25	.12	9.1	—	34.0	.76	143.8
DRUG MANUFACTURERS									
Synbiotics (SBIO/NASDAQ)	1/21	59.3	10.75	-.01	NE	—	97.7	.05	6.4
Nature's Bounty (NBTY/NASDAQ)	2/83	50.0	2.25	NC	NC	—	12.5	.30	NC
Leiner P. Nutri. (PLI/AMEX)	3/82	47.1	9.75	.21	-22.2	—	10.6	.00	68.8
Hycor Biomed. (HYBD/DTC)	4/20	38.0	1.38	.01	NE	—	27.5	.08	7.3
Comb. Bio. Sci. (CBCX/NASDAQ)	5/11	37.8	12.75	-.20	NE	—	NE	.01	3.6
Chattam (CNTT/NASDAQ)	6/22	35.3	23.00	.19	-9.5	.56	22.8	.56	58.3
Adv. Magnetix (ADMG/NASDAQ)	7/18	30.4	7.50	.11	37.5	—	19.7	.00	4.7
Mylan Labs (MYL/NYSE)	8/73	28.0	10.88	.15	7.1	.10	16.2	.07	93.4
Bolar Pharm. (BLR/AMEX)	9/78	25.7	22.00	.23	53.3	.03	33.8	.00	70.9
Forest Labs (FRX/AMEX)	10/85	25.5	20.25	.23	15.0	—	22.3	.01	77.8

The HIGH TECHNOLOGY BUSINESS Leading 100 lists the 10 companies in each of 10 industries that had the highest stock gain over the previous month (figures as of 3/7/88).

NA — Not available NE = Negative earnings NC Not calculable NM No meaningful figure

COMPANY (SYMBOL/EXCHANGE)	RANK THIS MONTH/ LAST MONTH	PRICE INCREASE LAST MONTH (%)	CLOSING PRICE (\$)	EARNINGS PER SHARE		LATEST DIVIDEND (\$)	P/E RATIO	DEBT/ EQUITY RATIO	LATEST 12 MONTHS' REVENUE (IN MILLIONS)
				LAST QUARTER (\$)	CHANGE FROM 1 YEAR AGO				
ELECTRONICS									
Compact Video (CVSI/OTC)	1/19	111.8	6.63	-.82	NC	—	NE	5.61	442.8
N. Hills Elec. (NOHL/NASDAQ)	2/57	83.3	2.75	-.04	NE	—	NE	.42	6.8
Cermetek Micro. (CRMK/NASDAQ)	3/202	70.5	1.50	.01	NE	—	NE	.05	7.7
Margaux (MRGX/NASDAQ)	4/3	68.7	2.75	.09	NE	—	NE	.23	17.9
Micron Tech. (DRAM/NASDAQ)	5/193	64.2	21.75	.33	NE	—	NE	.34	115.6
Tekelec (TKLC/NASDAQ)	6/195	62.5	6.50	.13	85.7	—	32.5	.01	17.0
Telemation (TUMT/NASDAQ)	7/222	60.0	2.00	.09	350.0	—	12.5	.44	11.4
Silicanix (SILI/NASDAQ)	8/205	57.1	6.88	.10	-16.7	—	22.9	.61	122.5
App. Materials (AMAT/NASDAQ)	9/206	56.7	27.63	.36	NE	—	56.4	.14	202.3
Fibronics (FBRX/NASDAQ)	10/34	52.1	4.00	-.06	-100.0	—	NE	.18	35.4
HEALTH									
Clini-Therm (CLIN/DTC)	1/116	112.0	1.06	-.04	NC	—	NE	1.89	4.5
Staar Surgical (STAA/NASDAQ)	2/91	90.6	2.63	.00	-100.0	—	29.2	1.78	6.6
Intl. Clin. Lab (ICLB/NASDAQ)	3/75	71.3	23.13	.15	400.0	—	31.3	.77	217.9
Life Tech. (LTEK/NASDAQ)	4/109	47.7	16.25	.18	38.5	—	19.8	.16	120.9
Sci-Med. Life (SMLS/NASDAQ)	5/48	43.9	13.50	-.11	-100.0	—	NM	.00	13.6
Biotech. Rsch. (BTRL/NASDAQ)	6/107	42.9	10.00	.05	NE	—	NM	.14	9.2
Psych. Biosci. (PSB/AMEX)	7/80	42.0	3.38	.03	NE	—	22.5	.00	6.1
Sunrise Medical (SNMD/NASDAQ)	8/90	41.7	8.50	.21	40.0	—	30.4	2.21	158.6
Vicon Fiber (VFDX/NASDAQ)	9/11	41.7	2.31	-.20	-100.0	—	NE	.46	10.6
Mono. Antibod. (MABS/NASDAQ)	10/5	39.9	4.38	-.33	NE	—	NE	.07	5.6
METALS FABRICATION									
Allied Products (ADP/NYSE)	1/33	34.6	17.50	.00	-100.0	—	10.9	.39	487.6
Schwab Safe. (SS/AMEX)	2/16	25.2	15.50	.31	.0	.56	12.6	.00	12.9
Temtex Ind. (TMTX/NASDAQ)	3/37	23.5	5.25	.19	850.0	—	12.5	.49	37.4
Reuter (REUT/NASDAQ)	4/18	20.4	9.63	-.04	-100.0	—	33.2	.52	25.7
Fla. Steel (FLS/NYSE)	5/32	19.9	32.38	.26	-51.9	.80	12.8	.61	419.2
Exposic Ind. (EXPO/NASDAQ)	6/5	19.1	14.00	.53	89.3	.24	8.6	.99	193.2
Clabir (CLG/NYSE)	7/39	19.0	2.38	-.10	NE	.16	NE	7.36	361.9
Graham (GHM/AMEX)	8/12	18.5	8.00	-.55	NE	—	6.2	.76	58.9
Coml. Metals (CMC/NYSE)	9/30	16.3	22.25	.45	164.7	.32	15.7	.23	900.7
Douglas Lomason (DOUG/NASDAQ)	10/23	16.0	19.00	1.29	1333.3	.50	6.2	.68	296.7
SCIENTIFIC AND ELECTRONIC INSTRUMENTS									
KeveX (KEVX/NASDAQ)	1/15	89.3	11.13	.14	250.0	—	33.7	.00	39.1
GCA (GCA/NYSE)	2/70	73.5	4.13	-3.50	NE	—	NE	.18	80.3
Entronics (ENTC/NASDAQ)	3/58	55.9	4.88	.02	-87.5	—	14.8	.00	6.5
Rheometrics (RHEM/NASDAQ)	4/32	36.8	6.50	.11	NE	—	72.2	.64	22.5
ECI Telecom. (ECILF/NASDAQ)	5/95	36.6	3.25	.07	NE	—	19.1	.23	24.5
Finnigon (FNNG/NASDAQ)	6/26	32.8	21.25	.36	NE	—	24.7	.36	110.3
Fischer & Port (FP/AMEX)	7/23	30.1	14.88	.62	82.4	—	27.0	.11	200.6
Kulicke & Soffo (KLIC/NASDAQ)	8/65	30.1	10.25	.00	NE	—	NE	1.00	67.6
Boonton Elec. (BODN/NASDAQ)	9/16	30.0	6.50	.10	100.0	—	13.8	.14	13.1
Esterline (ESL/NYSE)	10/33	30.0	13.00	-3.57	-100.0	—	NE	.35	259.7
SOFTWARE AND DATA PROCESSING									
Wilond Svcs. (WSVS/NASDAQ)	1/57	87.3	2.81	.15	NE	—	40.2	1.35	15.1
Decision Sys. (DCSN/DTC)	2/49	66.7	3.75	-.06	-100.0	—	NE	.00	5.8
Computrac (ILB/AMEX)	3/10	62.5	3.25	-.17	-100.0	.07	NE	.11	7.7
Cognos (COGN/NASDAQ)	4/75	61.1	7.25	-.19	-100.0	—	25.0	.19	74.7
Software Pub. (SPCO/NASDAQ)	5/22	52.0	13.88	.34	100.0	—	16.1	.00	43.9
MTech (MTCH/NASDAQ)	6/43	48.7	29.00	.42	61.5	—	22.7	.21	232.1
Data Arch. (DAI/AMEX)	7/83	46.6	13.75	.23	9.5	—	17.2	.02	34.7
Irwin Magnet. (IRWN/NASDAQ)	8/133	43.4	7.00	.16	-11.1	—	12.5	.00	51.1
Soft. AG Sys. (SAGA/NASDAQ)	9/82	42.8	11.25	.11	-35.3	—	15.8	.01	70.6
Autodesk (ACAD/NASDAQ)	10/130	41.4	24.75	.27	58.8	—	27.8	.00	79.3

SOURCE: MEDIA GENERAL FINANCIAL SERVICES

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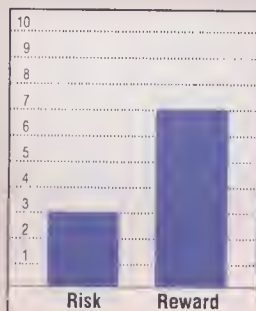
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2. Estimated 1988 Revenue	\$2.5 B
3. Earnings Per Share:	
last quarter	\$.29
last fiscal year	\$.55
4. Estimated Earnings Per Share:	
next quarter	\$.40
next fiscal year	\$1.90
5. Recent Stock Price	\$30
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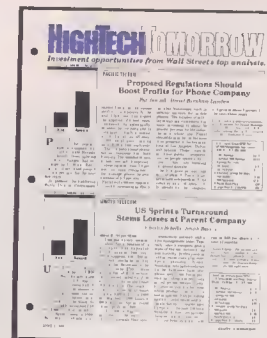
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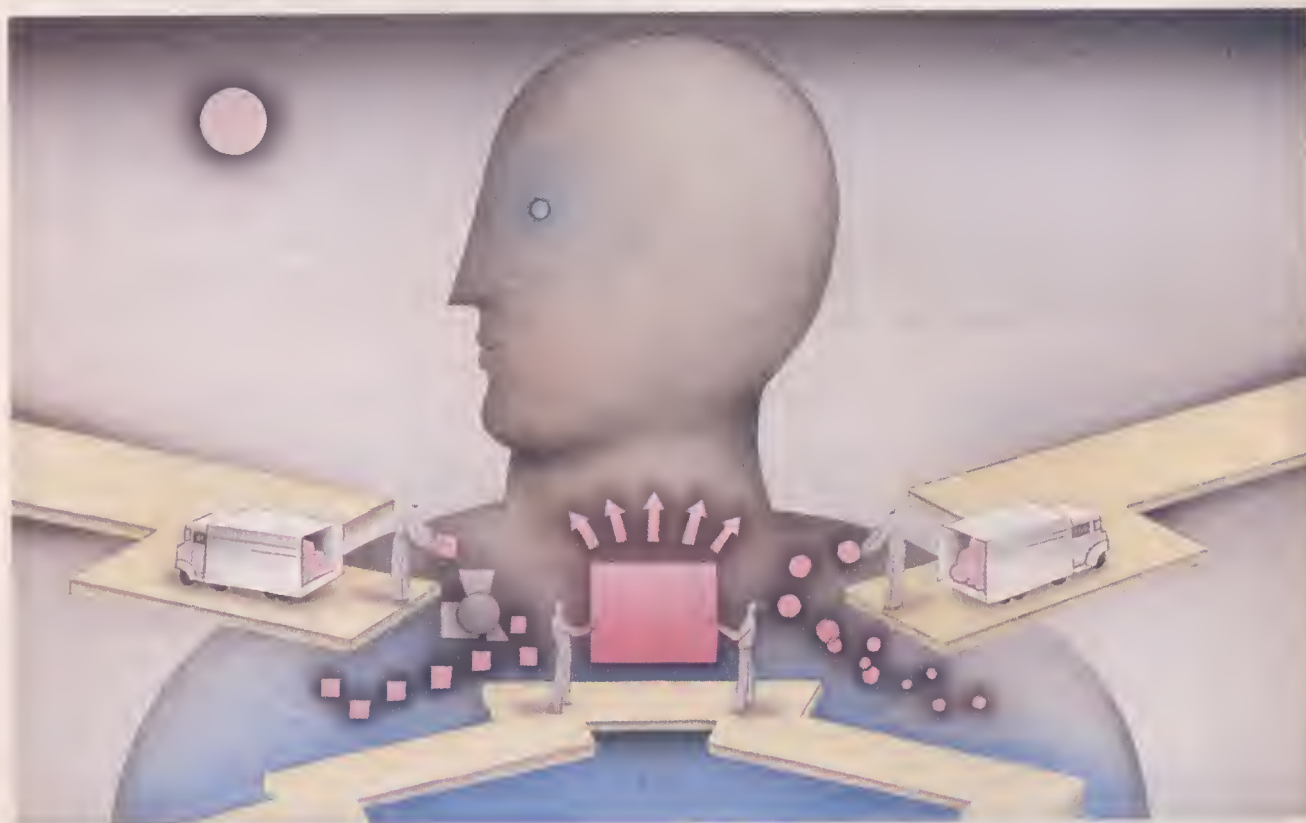
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New Methods Deliver Medicine and Profits

Better ways to administer drugs offer opportunities for small companies

BY FRANCESCA LUNZER



JAMES ENDICOTT

FOR YEARS, George Ovetsky suffered from heart pain so severe he could walk only a few steps before he had to stop and rest. Two years ago, his doctor prescribed a patch to deliver constant doses of nitroglycerin through his skin. Now Ovetsky, a 62-year-old retired salesman, enjoys greater freedom of movement. "This certainly makes me much more comfortable," he says.

Ovetsky's Ciba-Geigy patch is just one example of new drug-delivery systems now entering the market. These systems make medication easier to take, reduce side effects, and treat diseases that can't be treated using conventional delivery systems.

Even though most drug-delivery systems sell drug manufacturers only the delivery technology, not the drugs themselves, the profit potential is very

high. Nina Siegler, a health-care analyst at Bradley & Company, estimates that by the early 1990s drug-delivery systems will capture 10 to 15 percent of an expected \$40-billion U.S. prescription-drug market.

Currently, at least 80 percent of all drugs are taken as tablets, capsules, or injections, but a host of new technologies promise to turn the market inside out. These technologies include con-

trolled-release pills, through-the-skin systems, nasal sprays, monoclonal antibodies, liposomes, and drug-filled polymers applied directly to affected areas.

No one knows which of these new approaches will be most profitable. With so many technologies being developed to deliver the same drugs, some companies could find themselves knocked out of the market by better systems. The large pharmaceutical houses are hedging their bets by conducting research on certain systems and also investing in smaller companies that make technology they can use with their drugs, says Linda Miller, a biotechnology analyst with Paine Webber.

But even if these new drug-delivery systems fulfill all their promises, observers expect traditional delivery systems to continue to dominate the market. "Tablets and capsules are still cheaper than the other technologies, and will stay that way at least through the 1990s," says James McCamant, editor of the newsletter *Medical Technology Stock Letter*.

Nevertheless, new methods offer undisputed benefits. Many new genetically engineered drugs are made of large protein molecules that the digestive system can't handle. Currently, these drugs are injected, but the goal is to cre-

ate better and easier methods for getting new medicines into the body.

With major pharmaceutical houses vying with a swarm of smaller companies to create the drug-delivery systems of the future, large companies are buying into their smaller competitors to gain access to the new technologies. For example, Eastman Kodak owns 12.6 percent of Cytogen Corp., which has developed a process for binding drugs to monoclonal antibodies, and American Home Products holds 9.3 percent of the same company.

Although some smaller companies are working on systems to deliver drugs made by big pharmaceutical companies, a few have been testing systems that include their own drugs. This strategy is more expensive, but it lets the company sell a whole product and not just rights to the delivery technology. California Biotechnology, for example, is developing Auriculin to treat high blood pressure, and hopes to administer the drug in a nasal spray.

The advanced drug-delivery market is still fairly small, made up almost entirely of improved pills and through-the-skin patches. Sales of advanced systems totalled only about \$364 million in 1986, including new intravenous systems, according to a market-research

report by Theta Technology Corp. But the Theta report predicts the market will reach \$1.1 billion by 1990, as awareness grows and new and better systems enter the market.

In addition to creating new markets, delivery systems may add years to the patent lives of existing drugs. According to market-research company Frost & Sullivan, by 1991 generic drugs will grab 40 percent of the total market as patents expire. But pharmaceutical companies can get new patents if they couple their drug with a new delivery system.

In many cases, however, delivery systems work best only for certain drugs. "In some cases just one system will win out, knocking the others out of the market," says Robert Langer, professor of chemical engineering at the Massachusetts Institute of Technology.

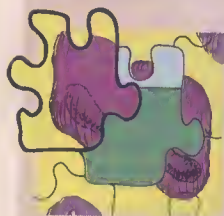
Although it's far too early for a market shakeout, observers are already choosing sides. "Ease of use is most important," says editor McCamant. "If two types of delivery system give you the same amount of drug and side effects, patients will prefer the one that's easiest to use."

Oral drugs will probably remain the dominant delivery system for a while, because consumers are used to tablets

GETTING DRUGS INTO THE BODY

Even the best medicine is useless without an efficient way to get it to the part of the body that needs it. A variety of new technologies are using innovative approaches to deliver drugs safely and precisely.

MONOCLONAL ANTIBODIES



Most drugs are needed only at certain places in the body; monoclonal antibodies promise to deliver them with pinpoint accuracy. These antibodies are molecules that attach only to specific substances in the body. They hold particular promise for delivering anticancer drugs, which can damage healthy tissue, but developers are still perfecting ways to reliably bind and detach the drug molecules and the antibodies.

IMPROVED ORAL SYSTEMS

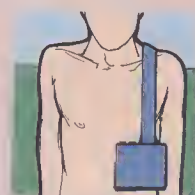


Drugs taken orally must travel through the digestive system, which tries to break them down before they can do

their work. To compensate, doctors are forced to prescribe high and frequent doses, which increases the risk of side effects.

Improved oral systems, many already on the market, are basically better versions of the "tiny time pills" made famous in 1960s commercials. The systems protect the drug until it has passed through the digestive tract, or release it into the body slowly. One system surrounds the tablet with a membrane; pressure in the digestive system slowly pulls the drug through a tiny hole, controlling the dose. Other systems have a chemical coating that slowly dissolves after the drug leaves the digestive system.

THROUGH-THE-SKIN SYSTEMS



Transdermal systems, which send drugs through the skin, are patches similar to adhesive bandages. The drug seeps from a

reservoir through the skin and into the bloodstream via capillaries, the tiniest blood vessels. Current patches can't control how quickly the body absorbs the drug, but some drugs don't need a precise dose to be effective.

Other drugs, including anticancer agents, demand more precise dosage control, and protein drugs such as insulin are too large to slip through the skin by themselves. A new patch from Drug Delivery Systems uses a battery to create a weak electrical charge that pushes drugs through the skin. An external system from Advanced Polymer Systems uses tiny spheres that absorb liquids and slowly release them on the surface of the skin.

and capsules. Although some companies are looking at polymers and coatings to make pills safer and easier to take, the fastest growth is expected to come in time-release forms that let patients take drugs less often.

At least three companies are taking major steps into time-release oral drugs: Alza, Elan, and KV Pharmaceuticals. Several smaller companies are also in the business. The field is attractive because royalties on new oral-delivery systems will range from 2 to 7 percent of a drug's total sales.

Alza's Oros time-release system is already used in two products and the company has new agreements in the works with Glaxo and Pfizer. Alza is trying to sign marketing as well as royalty agreements for the Oros system once current agreements expire.

Elan, meanwhile, has licensed its proprietary time-release system for Cardizem to Marion Laboratories. The FDA could approve Cardizem for treating heart pain this year, according to Peter Daly, an analyst with J&E Davy in Ireland. He says Cardizem sales could reach \$900 million by 1990 and projects a 2.5 percent royalty for Elan. This could bring the company \$8 million in royalties in 1990.

However, Marion's Cardizem patent

runs out in 1992, and other companies are already working on competing time-release formulas. Marion's early start will give it a marketing advantage, and the company is beefing up its sales staff to stay on top.

Elan is also developing eight other time-release oral systems, including one for Sandoz, which hopes to file for FDA approval next year. Elan also aims to create complete products by combining the drug and the delivery system. A through-the-skin, or transdermal, patch designed to deliver nicotine to help smokers quit could earn sales of \$150 million by 1993, says Daly.

KV Pharmaceuticals, active in the time-release oral-system business for more than 30 years, already earns profits from its KV 24 formula, introduced in 1984. This system uses a combination of polymers and coatings to let patients take their medication just once a day. The company has signed more than 70 marketing agreements and has licensed the KV 24 technology for several over-the-counter drugs. KV Pharmaceuticals hopes its deal with Johnson & Johnson to develop KV 24 for Hismanal—an antihistamine that doesn't cause drowsiness—will turn out to be a blockbuster.

Even though large pharmaceutical houses are anxious to license improved

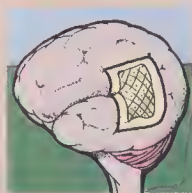
oral-delivery systems from small, specialized companies, most are also working on technologies of their own. The big companies hope to market time-release drugs without having to pay royalties. "We are licensing delivery technology," says Anthony Sinkula, director of drug-delivery systems at Upjohn, "but we are also doing lots of work in house." If the major companies prove successful, the boom for smaller players could be short-lived.

Although oral systems are chasing the biggest potential market, systems that deliver drugs through the skin rule the biggest share of the advanced drug-delivery market, with 1987 sales of more than \$300 million. Sales will hit \$800 million by 1990, according to analysts at Theta Technology.

Such patches are now available to deliver nicotine, motion-sickness medication, high-blood-pressure drugs, estrogen, and nitroglycerine through the skin. The nitroglycerine patches, which alleviate the pain of angina, represent 83 percent of the market, which is shared by Ciba-Geigy, Searle, and Key Pharmaceuticals. Ciba-Geigy leads the pack with a patch developed by Alza.

Patches have seen only a limited market because protein-drug molecules are too large to seep through the

POLYMERS

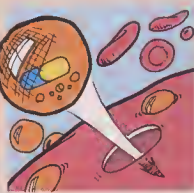


Polymers, which can be even more site specific than monoclonal antibodies, may be injected, swallowed, or applied surgically to diseased areas of the body.

These small, thin sheets of plastic material hold a drug in layers, release it over time, then disintegrate safely when all the medication has been delivered. The most important site for polymer-based delivery systems may be the brain, because the blood/brain barrier, a membrane that keeps foreign molecules out of the brain, also bars many therapeutic drugs.

Nova Pharmaceutical is currently testing a polymer system on 10 patients with brain tumors. Polymers may also help patients suffering from such common brain diseases as Alzheimer's and Parkinson's, and may help treat some people with AIDS.

LIPOSOMES

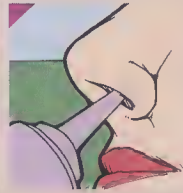


Liposomes, tiny spheres made of fat, hold drugs and protect them until they reach the bloodstream.

The red blood cells then absorb the fat, releasing the drugs. Because the entire dosage reaches the spot that needs it, doses can be drastically reduced. Initial versions will be taken intravenously, but companies are also working on nasal-spray versions and products that can be applied to the skin. Liposome Company, Vestar, and Liposome Technology are conducting clinical trials using liposomes to treat cancer, immune diseases, hair loss, and asthma.

Liposomes are very good at delivering drugs for blood, liver, and kidney ailments, but useless for many other afflictions because they are restricted to the bloodstream. Also, liposomes disappear from the body very quickly.

NASAL SPRAYS



Unlike traditional nasal sprays, nasal delivery systems now under development go beyond the mucous lining of the

nose to carry medication such as insulin to the bloodstream. Other possible uses include administering vitamins.

OTHER TECHNOLOGIES



Other systems under development include Pharmatec's chemical carrier that passes drugs through the blood/brain

barrier, Daltex Medical Sciences' drug coatings for medical devices, Molecular Biosystems' magnetic drug-delivery system, and Alza's disposable intravenous infuser.

MATT ZANG

WHO MAKES DRUG-DELIVERY SYSTEMS

COMPANY	PRODUCT(S)	MKTG. PARTNERS	INTRODUCTION
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ORAL DELIVERY SYSTEMS

Alza Box 10950 Palo Alto, CA 94303 (415) 494-5222	A time-release appetite suppressant, time-release Vitamin C	Several	Already on the market
Elan Monksland, Athlone Republic of Ireland 01-1353-9029-4666	Time-release microspheres	Several	Already on the market
KV Pharmaceuticals 2503 S. Hanley Rd. St. Louis, MO 63144 (314) 645-6600	A wax coating for timed release	Several	Already on the market
Pennwalt 755 Jefferson Rd. Rochester, NY 14623 (716) 475-9000	A liquid time-release system	Several	Already on the market
Verex Laboratories 14 Inverness Dr. East Englewood, CO 80112 (303) 799-4499	Several time-release technologies	Several	Already on the market

MONOCLONAL ANTIBODIES

Bio-Response 1978 W. Winton Ave. Hayward, CA 94545 (415) 786-9744	Monoclonal antibodies to be linked with other companies' drugs	Several	Already on the research market
Celltech 244-250 Bath Rd. Slough, England SL1 40Y 011-447-533-6162	Monoclonal antibodies to be linked with other companies' drugs	Several	Already on the research market
Cytogen 201 College Rd. East Princeton, NJ 08540 (609) 452-8838	A process to bind drugs to monoclonal antibodies	Kodak, American Cyanamid, Adria Laboratories	Undetermined
Damon Biotech 115 4th Ave., Needham Heights, MA 02194 (617) 449-6002	Monoclonal antibodies to be linked with other companies' drugs	Several	1981

THROUGH-THE-SKIN DRUGS

Advanced Polymer Sys. 3696C Hoven Ave. Redwood City, CA 94063 (415) 366-2626	Microsponges for topical drugs	Sterling Drug, Scott Poper, Pierre Fabre	1990
Alza	Motion-sickness drug	Cibo-Geigy	1981
Drug Delivery Systems 292 Madison Ave. New York, NY 10017 (212) 879-2300	An electric patch to deliver the hormone LHRH to treat prostate cancer	None	1989
Elan	A nicotine patch	None	1987
Exovir 111 Great Neck Rd. Great Neck, NY 11021 (516) 466-2110	An ointment to treat genital and oral herpes	None	Plans to file for FOA approval this year
Heraon Laboratories 200 8 Corporate Court S. Plainfield, NJ 07080 (201) 755-7730	A nitroglycerine patch	Bolar Pharmaceutical	1986
Molecular Biotech 230 Alleany St. Cambridge, MA 02139 (617) 577-9900	Patches to deliver heart drugs, estragen, and nicotine	Negotiations pending	Undetermined
Thermedics 470 Wildwood St. Woburn, MA 01888 (617) 938-3786	A wound dressing to deliver coagulants and fight infection	U.S. Army	Undetermined

COMPANY	PRODUCT(S)	MKTG. PARTNERS	INTRODUCTION
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POLYMERS

Alza	Under/through-the-skin, rectal, and inter-muscular polymers	Seeking partners	Undetermined
Bend Research 64550 Research Rd. Bend, OR 97701 (503) 382-4100	Oral and implant polymer technologies for use by other companies	Upjohn, Burroughs Wellcome	Undetermined
Enzotech 7630 Concord Ave. Cambridge, MA 02138 (617) 661-0940	Polymers for protein delivery	Not available	Undetermined
Eurand America 845 Center Dr. Valhalla, OH 45377 (513) 898-9669	Polymer-based potassium-chloride capsules, among others	A.H. Robins	Already on the market
Nova Pharmaceutical 5210 Eastern Ave. Baltimore, MD 21224 (301) 522-7000	A polymer implant for brain-cancer chemotherapy	None	Early 1990s
Vipont Pharmaceuticals 220 E. Olive St. Fort Collins, CO 80524 (303) 482-3126	A polymer implant for advanced gum disease	None	Early 1990s

NASAL DELIVERY SYSTEMS

California Biotechnology 2450 Bayshore Parkway Mtn. View, CA 94043 (415) 966-1550	A nasal spray for insulin	Eli Lilly, Wyeth	1990s
Nastech Pharmaceutical 800 Vet. Mem. Hwy. Hauppauge, NY 11788 (516) 361-8880	A nasal spray for Vitamin B-12	Seeking marketing partner	Undetermined

LIPOSOMES

Liposome Company 1 Research Way Princeton, NJ 08540 (609) 452-7060	Liposomal anticancer drugs	None	Early 1990s
Liposome Technology 1050 Hamilton Court Menlo Park, CA 94025 (415) 323-9011	A liposomal asthma therapy and eye drops	Cooper Bio., Astra Group, Riker/3M, Barnes-Hind	1990s
Vestor Research Box 60970 Pasadena, CA 91106 (818) 792-6101	Liposomal anticancer drugs	Lyphamed	Early 1990s

OTHER TECHNOLOGIES

Daltex Medical Sciences 44 Eagle Rock Ave. West Orange, NJ 07052 (201) 325-8600	Drug coatings for medical devices	C.R. Bard, Foley Catheter, Block Drug	1990s
Enzon 300 Corporate Court S. Plainfield, NJ 07080 (201) 668-1800	A chemical-delivery system for cancer and urinary-tract-infection treatments	Eastman Kodak	Early 1990s
Molecular Biosystems 11180 Roselle St. San Diego, CA 92121 (619) 452-0681	A magnetic system that draws drugs into the bloodstream	None; a potential agreement with Eli Lilly was cancelled	Undetermined
Pharmatec Box 730 Alochua, FL 32615 (904) 462-1210	Redox, a chemical to carry drugs to the brain	Gynex (for a birth-control pill)	Mid-1990s

skin. However, an improved version from Drug Delivery Systems uses a weak electrical charge from a battery to push drugs through the skin. The device, called the Powerpatch, has grabbed 10 patents. Executive vice president Sanford Rosen acknowledges that the initial price will be higher than that of passive patches, which cost about \$1.50 per use. But he says that mass production and the company's refillable drug reservoir should make the Powerpatch competitive. The first version to hit the market will probably deliver the hormone LHRH to treat prostate cancer.

Alza has the most patches on the market, but the ability of the Powerpatch to deliver many drugs that Alza's current technology cannot may let Drug Delivery Systems catch up.

Advanced Polymer Systems is also working on a system to deliver drugs on the skin. The company has licensed its microsphere system for gradually releasing treatments, cosmetics, and sunscreen onto the surface of the skin. A deal with Sterling Drug (owned by Eastman Kodak) will let Sterling use the technique for eight new products, including a lotion designed to tap the \$3-billion sunscreen market. Advanced Polymer Systems hoped to introduce its first product by this summer, but no firm date has been set.

Only two companies are active in the promising nasal-delivery arena: California Biotechnology (Cal Bio) and Nasstech Pharmaceutical. Both have developed ways to get large protein-based drugs into the body through the nose, but Cal Bio's technique more closely mimics the way the body delivers its own proteins—in spurts rather than continuously. Cal Bio has licensed its Nasdel system to several companies, including Eli Lilly and Wyeth Laboratories, for testing with insulin. Tiny Nasstech Pharmaceutical makes a nasal-spray form of Vitamin B-12, but the company is still looking for a partner to help it market the product.

Nasal delivery systems are relatively cheap to make, but development and marketing costs will be substantial, and variables such as colds and sinus problems can interfere with delivery of the medication.

Yet another new technology area involves site-specific delivery systems. Monoclonal antibodies—proteins that bind only to the specific substances in the body they were designed for—are

by far the hottest part of this market. Damon Biotech, Bio-Response, and Britain's Celltech are already making money selling custom monoclonal antibodies to the research market. Hundreds of companies that are developing monoclonal-based tests and treatments buy their monoclonal antibodies from third-party companies.

This market could reach nearly \$2 billion by 1990, predicts Boston Biomedical Consultants, a research firm. A cloud hangs over such predictions, however. Unless someone solves the riddle of how to reliably attach a drug to monoclonal antibodies and detach it at the delivery site, the research market will never blossom into a therapy market.

The fate of monoclonal antibodies will reverberate throughout the pharmaceutical industry. Many biotech companies have monoclonal-antibody drugs in their arsenals, for both diagnostic and therapeutic uses. If monoclonal technology doesn't pan out, companies such as Eastman Kodak, Cetus, and Centocor stand to lose products they're counting on for hundreds of millions of dollars in sales.

Cytogen, which had 1986 sales of \$3 million, is a leader in the race to solve the problem of binding and detaching drugs to monoclonal antibodies, or "linking." If its solution works, the corporation could receive patent revenue from companies using its linker technology. Cytogen currently has licensing agreements with Eastman Kodak, Adria Laboratories, and American Cyanamid.

On a different front, several companies have organized efforts to develop polymer systems—thin sheets of plastic that lodge in the body and deliver drugs slowly over a long period of time, eventually disintegrating harmlessly. Last year, Nova Pharmaceutical Corp. formed a \$42-million limited partnership, in part to fund research on polymer delivery systems for brain tumors. Only about 10,000 people received treatment for brain tumors last year, but Nova hopes the polymer will work on other brain disorders as well, such as Alzheimer's and Parkinson's diseases.

Perhaps the most esoteric drug-delivery system under development involves liposomes, tiny spheres made of lipids, the fat found in cell membranes. These microspheres hold drugs and deliver them directly to red blood cells.

Three small public companies—Lipo-

some Company, Liposome Technology, and Vestar Research—have siezed the lead from these large pharmaceutical houses in the development of these systems. Although none of the companies expect to introduce a product before the early 1990s, all have collaborations with larger firms that have started to bring in research funding. All three companies are focusing on delivering anticancer drugs, and all are either at or close to the human-test stage.

It's too early to assess the market potential of liposomes, but the technology has limitations. For one thing, liposomes are too large to pass through the tiny walls of capillary blood vessels, and thus will work only against certain diseases.

Several other innovative drug-delivery technologies are under development. Enzon Inc. is looking into chemical coatings that fool the body into accepting drugs it would otherwise excrete. Molecular Biosystems hopes to use magnetism to draw drugs into the bloodstream, and Pharmatec is trying to develop chemicals that take a drug through the blood/brain barrier, a membrane that keeps foreign molecules out of the brain.

Daltex Medical Systems is working on a way to carry drugs into the body through coatings on medical instruments, and has contracts with several medical-device makers. The technology could be used to apply medicine right where it's needed—for example, coating a urinary-tract catheter with antibiotics to help prevent infection.

As the various systems fight for market share, it can be hard to tell who's on top. "You have a number of emerging companies in drug delivery, each attempting to solve the same problems with radically different technologies," says Miller of Paine Webber. "No approach could be called the clear winner, which makes it confusing."

The lure of substantial profits keeps the players interested. "Some of these technologies, such as transdermal patches and liposomes, will cost only a few cents per dose in mass production," says Bradley's Siegler, "but you charge what the market will bear." Obviously, insurance companies and the government will have something to say about the prices they're willing to pay, but "patients will do almost anything to avoid side effects," says Rosen of Drug Delivery Systems. "What's that worth to you?" ■

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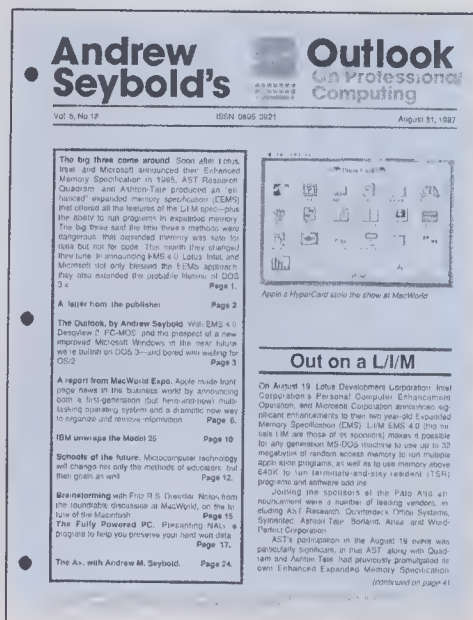
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Picking Up the Pieces Of RCA

*Post-GE spin-offs prove that high-technology components
of large corporations often do better on their own*

BY HERB BRODY

IT WAS THE merger of the decade—oil companies excluded, the largest corporate acquisition in the history of American business. Now, two years after General Electric swallowed RCA, GE has stripped its new possession of many of its defining features. Like crumbs swept off the table after a hearty meal, technology-oriented pieces of RCA adorn the corporate landscape.

GE started housecleaning almost immediately after completing the \$6.4-billion acquisition and has yet to slack off. In recent months, the company announced the sale of RCA's Global Communications unit—the kernel around which RCA was formed—as well as the Telephone Systems business.

Most of the divested operations are doing just fine under new ownership, and no major RCA operation has yet closed its doors.

The problems and opportunities confronting the spin-offs as they leave a huge and tradition-laden organization such as RCA are not unique. As U.S. business continues its brisk round of mergers and acquisitions, other technology conglomerates will be forced to change their stripes. The experiences of the former Record Company of America illuminate the promise and pitfalls of dismembering broad-based technology companies.

Some of the changes forced on RCA



*Erich Burlefinger built his company from
RCA's doomed New Products division.*

by GE have little to do with technology. Divested divisions include carpet-maker Coronet Industries, sold to CI Holdings; RCA Records, which went to West Germany's Bertelsmann A.G.; and several NBC radio stations that now belong to Westwood One.

But RCA was essentially a technology company, and most of the changes directly affect the high-tech community. GE bartered RCA's consumer-electronics business to French giant Thomson, gave the David Sarnoff Research Laboratories outright to SRI International, agreed to sell the Telephone Systems business to Mitel, and is awaiting government approval on a deal to transfer RCA Global Communications to MCI. Cylix Communications Corp., a provider of satellite-based data networks, has been sold to its management, as has the New Products division.

GE defends slicing up RCA as an attempt to pursue its vision of an uncluttered corporate strategy. The company wants to concentrate on three general areas: services, core manufacturing (such as appliances and light bulbs), and high-profit technologies such as aerospace, medical systems, and electronics. In GE's view, the RCA operations it has retained—including NBC, several defense units, semiconductors, and a domestic satellite-communications company now called GE American Communications—all fit under one of these three umbrellas.

For the divested companies, departure from RCA is a double-edged sword. RCA's size, reputation, and stability sheltered its corporate members from the harsher elements of the business world. But independence brings a refreshing absence of bureaucracy and the ability to act swiftly to exploit a fleeting market trend or forge strategic alliances with other companies. Even the nonentrepreneurial spin-offs seem to be leaving RCA for better homes, or at least more attentive ones. Over its nearly 70-year history, RCA evolved into an eclectic mix of businesses, and inevitably some divisions received less support than others.

Now that RCA has ceased to exist as a corporation, its heritage is also facing mortality. The two companies salvaged from RCA's New Products division illustrate both the lingering power and the slow fading of the RCA name. Established a mere two years before the GE takeover, the division had an unusual setup. Officially charged with devel-

oping new products for RCA, its "greenhouse" activity was by definition unprofitable, at least over the short term. To cushion the losses, RCA based the division in Lancaster, Pa., alongside two established and profitable businesses: closed-circuit TV surveillance systems, and vacuum tubes for TV cameras and other equipment.

GE wasted little time in abandoning this cozy corner of RCA, which employed more than 1,000 people. GE decided to keep one segment of the Lancaster operation that makes lasers and light-emitting diodes, merging it with a GE facility in Montreal that produces similar devices. As for the rest, GE announced in July 1986 that it planned to sell the division or close it down.

Management coalesced into two groups to rescue the threatened organization. The larger group was led by Erich Burlefinger, then vice president

■

*Like crumbs swept
off the table
after a hearty meal,
technology-oriented
pieces of RCA adorn
the landscape.*

■

and general manager of the New Products division. Last July, Burlefinger and five associates bought out the vacuum-tube and security-products operations to create a new company called Burle Industries. These RCA veterans own 90 percent of the new enterprise, says president and CEO Burlefinger.

"The New Products division didn't fit GE's corporate strategy, even though it was profitable," says Burlefinger, who will not disclose what he paid for the division. Burlefinger's crew had a crucial advantage over other bidders: They alone offered to buy the entire division and keep it in Lancaster. Burlefinger says the new company is making profits of 4 to 5 percent on sales of about \$120 million a year.

RCA's glacial bureaucracy had stymied the New Products division's growth. Several years ago, Burlefinger recalls, the division sought to acquire

two companies that made support equipment. It took two years to convince RCA management to approve the acquisitions, and by that time the companies no longer wanted to be bought. Burle Industries "can make that kind of decision in a few weeks," he says.

Burle continues to play off its RCA past—a heritage that's particularly valuable in a mature industry whose customers are used to stability. "We're stressing that Burle Industries is just a new name," says Burlefinger.

For Cardinal Technologies, the other company to emerge from the New Products division, the RCA affiliation has less value. Cardinal, formed in a separate management buyout led by Harold Krall, includes the research activities of the division and thus focuses on more innovative areas. The company expects to turn a profit this year on sales of about \$20 million.

The RCA connection "works both ways for us," says president Krall. In the eyes of young engineers, he contends, RCA "had become a has-been." The RCA name does help establish credibility when dealing with financial people and foreign companies, but Cardinal finds it a marginal marketing tool.

Krall hopes to make Cardinal a big player in the emerging market for home automation. In the meantime, the company makes its living by manufacturing data-display terminals and performing contract engineering and manufacturing. Krall claims that the company's highly automated plant can make terminals more cheaply than can facilities in the Far East.

Cardinal sells its terminals to the computer industry, and is working on a home videotex terminal that would give consumers access to a variety of information services. Cardinal has sold a few terminals to the regional Bell telephone companies for small-scale trials.

Like Burle Industries, Cardinal itches to exploit its new freedom. RCA had frustrated the group's attempts to move into the personal-computer market. "We already make most of the pieces that go into a personal computer," says Krall, "but RCA wouldn't let us build one." Now Cardinal may use its low-cost manufacturing capability to produce a competitively priced desktop computer in the United States.

Cylix tells a different story. Unlike Burle and Cardinal, the management buyout of Cylix reestablished the company's independence instead of declar-

THE RCA PIECES AND WHERE THEY FELL

DIVESTED UNIT	1987 REVENUE	MAIN BUSINESS	FATE	NEW OWNER
Consumer Electronics 600 North Sherman Dr. Indianapolis, IN 46201 (317) 267-5000	\$3 billion	Television sets, audio products, telephones	Bartered to Thomson S.A. in exchange for a medical-imaging business; Thomson is a \$9-billion company owned by the French government.	Thomson S.A. 173 Boulevard Houssmann 75379 Paris (Cedex 08), France 1-45619600
Cylix Communications 800 Ridge Lake Blvd. Memphis, TN 38119 (901) 761-1177	\$20-25 million	Satellite networks for data communications	Bought out by its management.	Naw on independent company
David Sarnoff Research Center CN 5300 Princeton, NJ 08543 (609) 734-2000	Not available	Wide-ranging research and development	Donated to SRI International; becomes a for-profit arm of SRI, a nonprofit contract-research company.	SRI International 333 Ravenswood Ave. Menlo Park, CA 94025 (415) 326-6200
Global Communications 201 Centennial Ave. Piscataway, NJ 08854 (800) 526-3969	Not disclosed	International communications carrier	Being sold to MCI Communications Corp., a \$3.9-billion telecommunications-services company.	MCI Communications 1133 19th St. N.W. Washington, DC 20036 (202) 872-1600
New Products division Lancaster, Pennsylvania	About \$120 million	Closed-circuit TV surveillance systems, vacuum tubes, computer monitors, and new-business development	Sold to two separate management groups to form new companies. Burle Industries received the surveillance systems and vacuum tubes; Cardinal Technologies got the monitors and new-product development. Cardinal also performs contract engineering and manufacturing.	Burle Industries 1000 New Holland Ave. Lancaster, PA 17601 (717) 295-6000 Cardinal Technologies 1827 Freedom Way Lancaster, PA 17601 (717) 293-3000
Telephone Systems Route 38 Cherry Hill, NJ 08358 (609) 338-6437	About \$30 million	Telephone-equipment distribution	Being sold to Mitel Inc., which is a wholly owned subsidiary of Mitel Corp., a \$340-million PBX manufacturer located in Canada.	Mitel 5400 Broken Sound Blvd. Boca Raton, FL 33487 (305) 994-8500

SOURCE: HIGH TECHNOLOGY BUSINESS RESEARCH

ing it for the first time. Cylix, launched in 1976 as a separate company, was the first organization to offer satellite-based networks for transmitting data. RCA bought the enterprise in 1982.

As RCA Cylix, the company posted annual sales of \$20 million to \$25 million. Then came GE, which wanted out of the data-communications business. Cylix president Bryan M. Eagle quickly put together a deal that let senior management buy the company.

When Cylix was part of RCA, it operated at a loss, which Eagle attributes to corporate overhead charges it was forced to absorb. "We always had a positive cash flow," he says, "and so we've been profitable since day one."

Like his counterparts at Burle and Cardinal, Eagle says independence will bring needed flexibility. Without RCA to insist on high margins, for example, Cylix can offer substantially lower prices. Such aggressiveness helped the company land a \$1-million deal with Purolator Courier of Basking Ridge, N.J. The Purolator contract would not have been possible with RCA running the show, according to Eagle.

Eagle projects annual growth of 50 percent for the next several years, mainly because of the surging market for very-small-aperture terminals, or VSATs—compact and relatively cheap satellite receiving stations that let companies send data to far-flung locations.

Cylix is one of three RCA telecommunications operations abandoned by GE. The company has also peddled its Telephone Systems division and RCA Global Communications (Globcom). Both are successful but do not fit into GE's strategic goals.

Globcom, the oldest piece of RCA, was formed in 1919 at the suggestion of the U.S. Navy, which wanted the country to establish a presence in the foreign-dominated business of wireless radio communications. RCA is now selling the 1,300-person operation to MCI International, a subsidiary of MCI Communications. Globcom has become a leading international record carrier, sending telex, facsimile, voice, data, and electronic mail overseas.

If the acquisition is approved by the Federal Communications Commission, MCI will pay \$160 million for Globcom.

As a telecommunications-service provider, Globcom fits perfectly with MCI and would presumably receive substantial corporate support. GE, by contrast, has declared its intention to quit the communications business.

On the equipment side, GE is selling RCA's Telephone Systems business, a unit of RCA Service Co., to Canada's Mitel Corp. It's a good match: Mitel makes telecommunications equipment—primarily private branch exchanges (PBXs)—and the RCA division sells these products. In fact, RCA has established itself as one of the country's top five independent distributors of telecommunications equipment, according to analyst Greg Carlsted at Dataquest.

About 60 percent of RCA's installed base of 1.5 million lines consists of Mitel equipment, but RCA also sells NEC and Hitachi products.

For Mitel, the acquisition is a defensive move. "In a mature marketplace such as PBXs, distribution is the key to success," says Carlsted. If Mitel didn't buy RCA's telephone business, a competitor would have—gaining control of Mitel's installed base and possibly lock-

ing the company out of an important distribution channel.

In getting rid of RCA's New Products division and telecommunications operations, GE was snipping around the edges of the historic company. But two other moves struck at RCA's core: giving away the David Sarnoff Research Laboratories, and selling the consumer-electronics business.

GE has a splendid research-and-development complex of its own in Schenectady, N.Y., so RCA's facility was redundant. Last year, GE donated the lab to SRI International, a non-profit research contractor. The David Sarnoff Research Center, as it is now called, operates as a for-profit subsidiary of SRI.

Sarnoff begins its new life with a five-year, \$250-million contract from GE. Only three-quarters of this money will go toward research for GE; the rest will cover more open-ended research "to develop new technologies for a different spectrum of customers," says James J. Tietjen, Sarnoff's chief operating officer and SRI's executive vice president. One prominent GE project is a new television broadcasting system that would provide better pictures (see "TV: The Push for a Sharper Picture," April 1988).

DAVID WAGENAAR

Sarnoff hopes to gradually wean itself from GE, reducing its former parent's contribution to about a quarter of total revenues. According to Tietjen, Sarnoff has signed contracts totaling about \$500 million with dozens of clients including Du Pont, Perkin-Elmer, and Matsushita. The lab expects annual revenues to grow 5 percent a year for the next five years.

Leaving RCA will bring fundamental changes. In the past, Sarnoff pursued whatever research it deemed interesting. This separated the lab from the rest of the company, says Tietjen. He points out that Sarnoff gave birth to several important technologies that RCA never used, such as liquid-crystal displays and two extremely popular types of semiconductor devices: metal oxide semiconductors (MOS) and complementary MOS (CMOS).

RCA scientists also get credit for many other notable firsts, including an all-electronic color TV and videotape recording. "They were doing R&D for the entire consumer-electronics industry," says David Lachenbruch, editorial director of the newsletter *TV Digest*.

Under SRI, the Sarnoff lab must justify itself in strict business terms. "We have much more of a customer orientation now," says Tietjen. The lab has set up its first marketing department and has advertised its services.

To most consumers, the name RCA

called Thomson Consumer Electronics, and Thomson keeps a 19 percent share of its medical-equipment unit.

Financially, GE's retreat from consumer electronics makes sense. Stiff competition from the Far East has driven profits down; RCA's consumer-electronics division barely broke even in recent years, and GE's was losing money, says Richard Miller, president and CEO of Thomson Consumer Electronics and former senior vice president of consumer electronics for GE.

Thomson inherited a slimmed-down operation. During the previous year, Miller had trimmed 23 percent of the operation's salaried employees and dismissed 15 percent of its hourly workers, consolidating operations from 23 plants into 17 to eliminate a quarter of fixed costs.

Miller sees a bright future. Unlike GE, he says, Thomson has a long-term commitment to consumer electronics. "We can now feel confident that we'll be in business a long time."

Whether or not dumping chunks of RCA turns out to be good for GE, it seems clear that the sold-off and given-away pieces have at least as good a chance to prosper now as they had as RCA dependents. At Cylix, Cardinal, and Burle, managers long bothered by corporate restraints are enjoying new freedom. These companies are guided by

people who know their products and markets intimately and have a personal stake in their success. Still, because the RCA buyouts are giving many owners their first stab at entrepreneurship, success is far from assured.

For the most part, the divisions GE sold to other companies will find themselves in more nourishing corporate habitats. RCA's diversity prevented it from focusing strategic resources on each unit. The Telephone Systems business and Globcom, which RCA treated as poor stepchildren, will become valued members of the family in their new homes at Mitel and MCI. Neglected outposts of the RCA empire are getting a chance to show what they can do under more attentive command.



An RCA deal made CEO Miller's Thomson the top color-TV maker.

means color television. Long before buying RCA, however, GE decided that consumer electronics did not fit into its plans, and the company steadily de-emphasized such activities. It stopped making its own TV sets, for example, choosing instead to slap its label on sets from Matsushita.

At the end of 1987, GE transferred control of all of its own and RCA's consumer-electronics businesses, including audio, video, and home telephones, to France's government-owned Thomson. The acquisition makes Thomson the world's largest producer of color TVs. In return, GE gained control of Thomson's medical-imaging business, plus an undisclosed amount of cash. GE retains 19 percent ownership of what is now

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were killed and 176 injured when an Amtrak
passenger train collided with Conrail freight
locomotives. Federal investigators, saying it
was too early to determine the cause, inten
sified their probe of the accident, focusing
on possible human error or equipment fail
ure (Story on Page 16)

centuries ago, but now it is arguably the
game of the world's elite.

The domain of racquets once was as
wide as the British Empire. But now the
game is so obscure that it is played by only
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private clubs. The secret formula for con
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NCR Chairman Charles Exley

ON MANAGING CHANGE

NCR CORPORATION IS more than 100 years old, which makes it a grand old sire in the youthful computer industry. But for NCR, age is not enfeebling. The company ranks among the top dozen computer makers, with strong positions in several significant segments such as retail and financial-transaction processing. NCR products include computer workstations for specific industries, large and multiple-user computer systems, communications processors, and related services.

The Dayton, Ohio, company used to make steel cash registers and mechanical adding machines. Not only has NCR changed with the times, it has prospered. When Charles E. Exley became president in 1976, the company had revenues of \$2.1 billion. In 1984, the year he became chairman and chief executive officer, NCR took in \$4.1 billion. Last year, the company's revenues stood at \$5.6 billion, yielding record per-share earnings of \$4.51.

To discover the secret of keeping a company youthful in these rapidly changing times, HIGH TECHNOLOGY BUSINESS assistant managing editor Jeffrey Zygmunt spoke with Exley, who has seen more than a quarter century of change in his industry.

■ *HT Business: How has the world changed for NCR?*

EXLEY: We're the founding company of what used to be called the office-equipment industry; this year marks

Charles E. Exley

Born: Dec. 14, 1929

Joined NCR: 1976

Responsibilities:

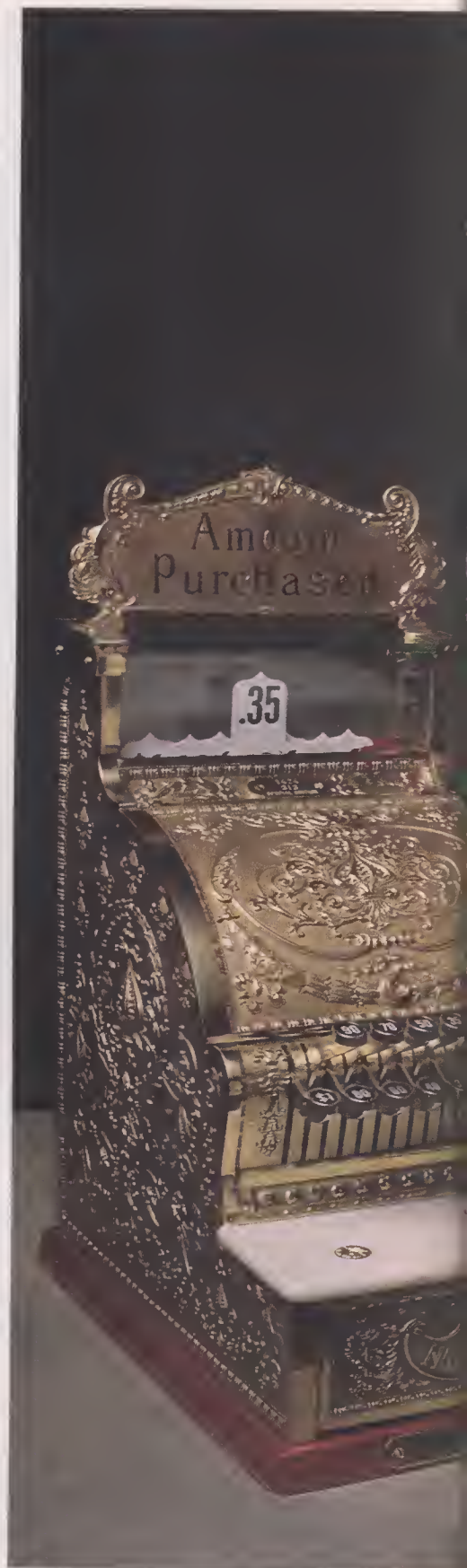
Strategic planning
and operational
management

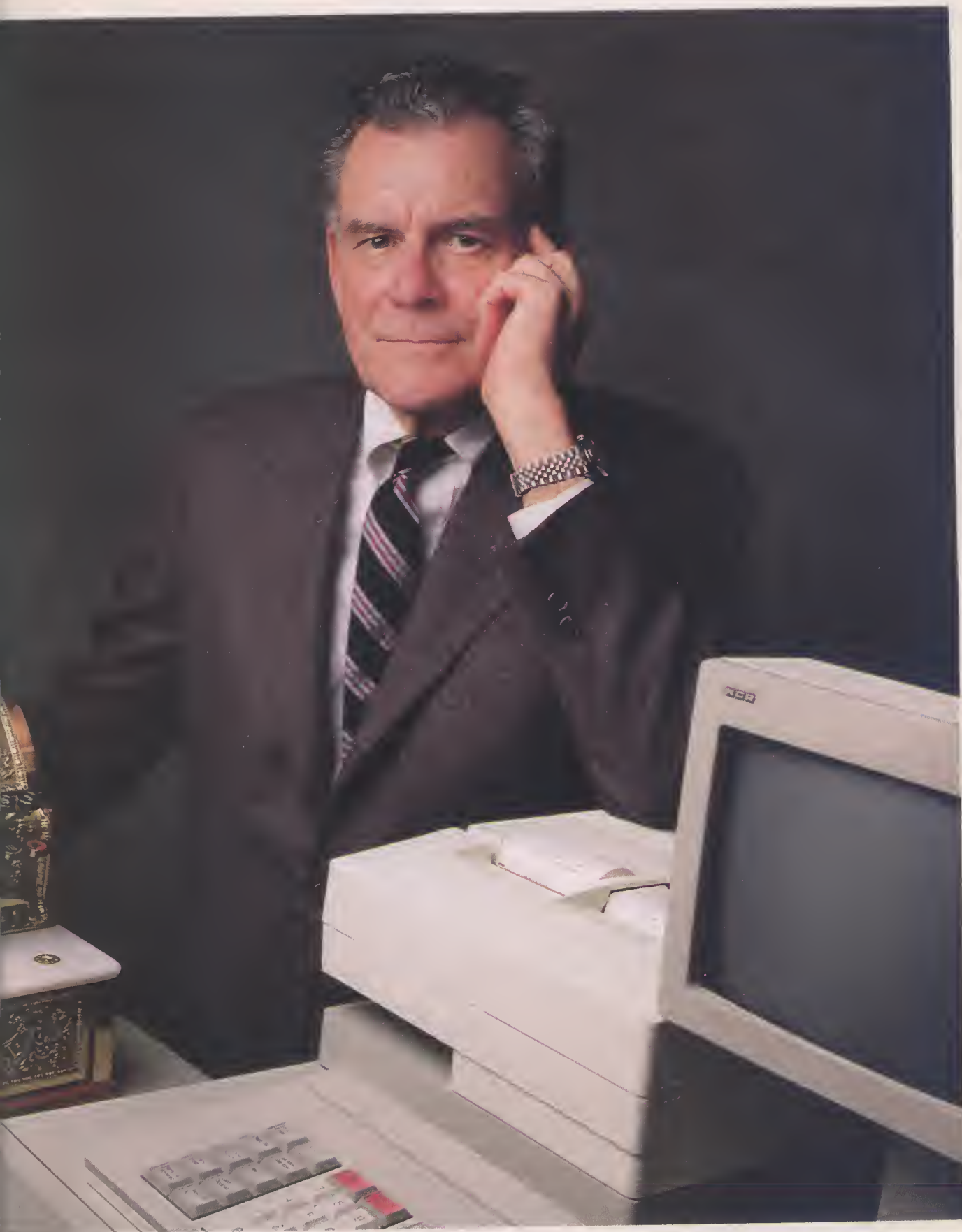
Revenue controlled:

\$5.6 billion in
1987

Employees:

62,000
1987 R&D budget
\$357 million





DAVID WAGENAAR

our 104th year. During that period we've seen enormous change, with the most dramatic changes in the last 25 years. Metalworking, the important technical base of our company, became obsolete and digital electronics became the technology on which the whole industry is based.

What is less often recognized is that, more or less at the same time, the accounting-machine business went from being a very large market, representing more than half of our business, to nothing. Basically, interactive direct-processing systems took the place of the accounting machine.

■ *HT Business: Is the pace of change increasing?*

EXLEY: It's probably soaring. In the 1970s and early 80s, change was driven by very-large-scale integrated-circuit technology and by the rapid increase in microchip densities. I think that in the 1990s we're going to see changes in software that are as dramatic as the hardware changes we've seen over the past 10 years.

I don't mean that hardware progress is going to stop; it's not. But we'll see great strides in software. That is happening now, because of the rapid reduction in the cost of executing an instruction and the very low cost of storage and memory. Some of the great ideas of the 1960s and 70s are becoming really practical today. Relational databases have been talked about for years, but they consume a great deal of power; now they're practical because the power is available at low cost.

Another thing that seems very clear is that so-called fourth-generation computer languages will become a major factor in the marketplace. This is of tremendous importance because it will increase our customers' ability to put our products to work in their businesses. Based on our own internal experience, these fourth-generation languages increase programmer productivity from four to ten times.

I think that the slowdown the industry experienced in the first part of the 1980s was attributable in large measure to our customers having exhausted the capacity to put our products to work. I don't think people were running out of things they wanted to do with computers; they were running out of the capacity to do the things they wanted to do.

■ *HT Business: Now software developments will let them do some of these things?*

EXLEY: And the consequence for the industry will be a nice growth spurt because of opportunities opened up by new software tools.

■ *HT Business: Growth in hardware as well as software?*

EXLEY: Yes, because all this new software consumes tremendous amounts of computer power. I think these are very bullish trends for the industry. This is as dynamic a period as I can remember in 33 years in the industry, maybe the most dynamic period.

■ *HT Business: What will happen to companies that fail to keep up with this technological change?*

EXLEY: The history of our industry says that such companies will disappear, usually by being absorbed by some other company. Of the great names in the office-equipment industry when I started in the business in 1954, there are just three surviving today in more or less the form they were in 33 years ago: NCR, IBM, and Olivetti. Other great names have disappeared from the industry—names such as Sunstrand, Remington, and Underwood.

■ *HT Business: Do you expect to see more consolidation in the computer industry?*

EXLEY: That depends in part on the success of the business combinations that have so far occurred [such as the merger of Burroughs and Sperry into Unisys]. If those are successful, then it's reasonable to expect that other combinations might take place. Preliminary indications seem to be favorable, but I think it's too early to come to conclusions.

Another important trend is the development of industry standards and open systems—two things not necessarily synonymous, but linked. We're going to see an increasing emphasis on them in the market and in the industry.

Standards are one of a number of dramatic developments over the last 25 years that have tended to decrease the importance of economies of scale for any particular company in our industry. That's why, despite predictions of increasing consolidation and just a few surviving companies, we continue to have very successful, dynamic new companies. Some of the most rapidly growing and strongest companies are among the newest. That's a sign of a healthy industry.

In hardware, an important supplier industry has developed because large segments of the industry make standardized systems. Standardized products provide large volumes that can be leveraged by a supplier of components such as keyboards, disk drives, or printers. Therefore the industry's economies of scale are available even to relatively small companies. Something similar has been happening in software in just the last few years. Certain kinds of products have become widely used in many manufacturers' products—for example, the Oracle database.

■ *HT Business: What measures can a company take to assure it doesn't fall behind in technology?*

EXLEY: It's important to spend enough money on product development. For 1988, the percentage increase in our development spending will approximately double the 8 percent rate of increase of the last few years. Also, you must be aware of what's happening and likely to happen in technology.

■ *HT Business: In other words, make sure your research and development dollars are going into the right areas?*

EXLEY: Into the right areas first from the standpoint of market opportunity, and second from the standpoint of the right technology for that market opportunity. You also have to understand the implications the technology has for your customers. That's sometimes the greatest challenge—to know what will be the big opportunities for a client.

■ *HT Business: But how do you know which areas are the right ones?*

EXLEY: It's both a great blessing and in some ways a curse that we have a very broad product range, with about 15 major product groups. It's a blessing in that it gives us the financial stability a more narrowly focused company does not have, because if you're basically a single-product company and you get out of step in the product cycle, you have big problems.

It's extremely unlikely that we would get out of step with product cycles in 15 different product lines. On the other hand, our diversity poses a management challenge. We have to be able to keep moving ahead on a broad range of products.

To do this, we have a more decentralized process than that of the industry in general. We have relatively autonomous di-

visions that make their own decisions on product programs. One of our vice presidents has described this as a "loosely coupled" management style. We couple the divisions first through an aggregate technology strategy advocated by the executive office and corporate research and development. But we also have overall computer-architecture concepts and agreed-upon points of commonality among the various development organizations. On the whole, we've made that work pretty well. There's no doubt that the amount of autonomy we allow individual decision-makers runs the continuous risk of producing misfits in our product range.

■ *HT Business: But you feel autonomy is important to keep development in the hands of the people who are closest to a particular market?*

EXLEY: That's our strong conviction. We want decisions made at the lowest possible levels in the organization, where the information that bears on the decision is available and where the results of the decision can be measured.

In addition, each of the development organizations has a charter describing what it's supposed to contribute as a part of the company.

■

**"This is as dynamic
a period as I can
remember in 33 years."**

■

■ *HT Business: How does financial strength affect a company's ability to keep up with technology?*

EXLEY: Financial strength is of fundamental importance. One of the basic points in our overall strategy is to have a very strong balance sheet. This is a capital-goods business, and therefore we have to contend with potentially dramatic cycles in our customers' spending patterns; we need the financial strength to carry us through lean periods. Also, this is a fast-moving industry, and it's always possible for a company to get out of step in the product cycle. In our long history we've had several occasions when that happened. With a balance sheet like ours today, this would be a perturbation, a problem to be swiftly addressed, but it would not be a threatening development for the future of our company.

If you look at successful companies in our industry, by and large you'll see very strong balance sheets, so I think there are many people who agree with my idea in the industry—or maybe I agree with their idea.

Also, I think people want to do business with a successful company. There's a kind of presumption—a reasonable one—on the part of our prospective customers that if their supplier is successful, it's more likely to have good ideas.

■ *HT Business: Is it hard to balance the need to gamble on rapidly changing technology versus financial security?*

EXLEY: It's easy to imagine circumstances over a short period of time in which the two could conflict. Product-development programs cannot be turned on and off and still be effective; once one is launched, you have to press ahead. A short-sighted management might attempt to cut back development programs quite dramatically in hard times.

Fortunately, NCR was able to get through the industry's difficult period in the early 1980s without a great deal of hardship. We did have a down year in earnings in 1981, but we decided to press ahead with our development programs. With that one exception, we have not faced the problem of declining earnings. But I would say that if we did face it, our decision would probably be to accept a mild dip in earnings, so long as our overall rates of return are high.

However, when discussions of long-run and short-run considerations emerge, somebody or other has observed that the long run is made up of a series of connected short runs. You can't very well run a business by having a long series of short-run failures in the hope of some very long-run success.

■ *HT Business: What about changing markets—can they be particularly troublesome in the computer industry?*

EXLEY: I think we have to recognize that all of these changes represent opportunities. When there are relatively few changes, you don't find very dramatic opportunities.

■ *HT Business: As the pace of change and the level of technology increases, is it getting harder to make the investments needed to get into new markets?*

EXLEY: Putting that question in the context of NCR's position, we're not anxious to add to the long list of products we now offer. Managing them is quite a challenge right now.

However, the opportunities for growth within a given product range are considerable. Take an historic example: supermarkets. Some 15 or 20 years ago, one could have said that the number of checkout lanes in U.S. supermarkets would not grow. Therefore, a static analysis would say that point-of-sale computer systems sold to food distribution would not grow. In fact, the industry had very strong growth in the dollar value of systems sold to that market.

The static analysis did not take into account the tremendous increase in functionality offered in those systems. Analysts were thinking of the number of cash points rather than the value per cash point that could be sold. The industry as a whole more than doubled the value per cash point by doing things like designing systems for scanning and for handling coupons, food stamps, and so on.

■ *HT Business: But in mature markets, how long can manufacturers continue to raise the value of equipment by adding functions?*

EXLEY: Nothing goes on forever, but it's hard for me to imagine that we will hit a ceiling in the balance of my career.

People tend to think about absolute limits. It was once thought that a speed of one mile a minute probably represented a limit that would never be exceeded. Maybe there's a general human proclivity to search for limits, but so far we haven't seen many examples of them. I don't see any prospective significant limits in the future of our industry between now and the turn of the century. ■

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Communications Equipment

OFFICE PRODUCTS



Video Briefcase transmitter. Model 290 sends and receives color or monochrome still-frame video pictures through telephone lines. It requires a standard video camera and monitor, plus a telephone with an RJ-11 modular jack. \$8,000. Colorado Video Inc., Box 928, Boulder, CO 80306. (303) 530-9580. *Circle 1.*

ColorEdge photocopiers. Model AC makes color copies from black-and-white originals, offering eight hues. It prints 70 copies per minute in one color, 35 per minute in two colors, and 23 per minute in three colors. \$54,000. A second model makes color copies from color originals at a rate of 23 pages/minute and costs \$59,500. Eastman Kodak Co., 343 State St., Rochester, NY 14650. (716) 724-3169. *Circle 2.*

Copy FX graphics paper. Made for photocopiers and laser printers; has a preprinted, graduated color background that simulates air-brushing. The 8½×11-inch paper comes in six colors. \$12.95 for 25 sheets. Letraset U.S.A., 40 Eisenhower Dr., Paramus, NJ 07653. (800) 526-9073; in N.J., (201) 845-6100. *Circle 3.*

Datashow projection pad. This device lets Apple Macintosh users display screen images as transparencies. It sits on top of an overhead projector and has a liquid-crystal display panel to show black-on-white images. The unit also acts as a large-screen projection monitor. \$1,495. Eastman Kodak Co., 343 State St., Rochester, NY 14650. (716) 724-3169. *Circle 4.*

ETV 2700 video typewriter. An MS-DOS system that serves as a personal computer, word processor, or typewriter. Includes a

built-in keyboard, a 12-inch black-and-white monitor, and one or two 3½-inch disk drives. \$1,649. Olivetti U.S.A., Office Products Division, 77765 U.S. Highway 202, Somerville, NJ 08876. (201) 526-8200. *Circle 5.*

FX facsimile machines. Models FX 2000 and FX 2100 transmit at 15 seconds/page. Both units handle oversized documents with automatic reduction and can make multiple copies. \$4,395 and \$4,795. Model FX 1000, for lower-volume use, sends documents at 25 seconds/page and also makes copies. \$2,595. Olivetti U.S.A., Office Products Division, 765 U.S. Highway 202, Somerville, NJ 08876. (201) 526-8200. *Circle 6.*

LAN Term diskless terminal. This desktop terminal acts as a personal computer but has no removable diskettes, to help assure data security. The unit works with other terminals in a local-area network, sharing data and software. \$1,095. Esprit Systems Inc., 100 Marcus Dr., Melville, NY 11747. (800) 645-4508; in N.Y., (516) 293-5600. *Circle 7.*

Image Phone video phone. Sends color still-frame video pictures over telephone lines from IBM PC/AT/XT and compatible computers. A package with an IBM PC/AT-compatible computer, a video-compression and capture board, a color camera, software, a modem, and a mouse costs \$12,995. The video-compression board is \$1,995. Star-Signal Inc., 1210 S. Bascom Ave., San Jose, CA 95128. (408) 294-9604. *Circle 8.*

Model 4250/4275 telephones. The 4250 handles two lines, offering intercom and paging features. Model 4275 adds the ability to store 40 phone numbers. \$179.95 and \$219.95. GTE, 1 Stamford Forum, Stamford, CT 06904. *Circle 9.*

RSVP 6000 voice-mail system. Answers the telephone and processes messages for as many as 24 people. The system works with touch-tone phones. \$7,000. AT&E Systems Inc., 1400 N.W. Compton Dr., Suite 300, Beaverton, OR 97006. (503) 690-2000. *Circle 10.*

Series NP-3000 copiers. Models NP-3725EF and NP-3725 print in two colors and let users edit images using an electronic pointer. The copiers also offer automatic exposure adjustment, two-page separation, frame erasing, and image shifting. Models NP-3225F and NP-3225 handle heavier vol-

umes. \$4,495 to \$6,495. Canon U.S.A. Inc., 1 Canon Plaza, Lake Success, NY 11042. (800) 652-2666. *Circle 11.*

SF-7300/7350 copiers. Two compact models print 13 copies/minute and have a front-loading paper cassette that holds 250 sheets. Model SF-7350 has three preset reduction and enlargement settings, including 64 or 75 percent reduction and 124 percent enlargement. \$1,795 and \$2,295. Sharp Electronics Corp., Sharp Plaza, Mahwah, NJ 07430. (201) 529-8920. *Circle 12.*

Synergy phone manager. Keeps track of telephone use, generating records for individual extensions and trunk lines. It also delivers summaries of phone use by department. The system consists of an expansion board and software and works with the IBM PC/AT/XT, PS/2, and compatible computers. \$1,995 for 25 phone lines; \$4,495 for 250 lines. MDR Telemanagement Ltd., 55A Port St. East, Suite 1, Mississauga, Ontario, Canada L5G 4P3. (416) 274-3317. *Circle 13.*

2104/2245 telephones. Model 2104 stores 32 numbers and offers pause, mute, and redial functions. Model 2245 adds a speaker for hands-free conversation and on-hook dialing. \$54.95 and \$64.95. GTE Consumer Communications Products Corp., 1 Stamford Forum, Stamford, CT 06904. (203) 965-2000. *Circle 14.*

COMPUTER HARDWARE



P321SLC color printer. This 24-pin dot-matrix printer offers seven colors, plus black, and operates at 216 characters/second in draft mode and 72 characters/second in letter-quality mode. Graphics resolution is 360×360 dots/inch. The printer has 32 kilobytes of memory. \$949. Toshiba America

Inc., Information Systems Division, 9740 Irvine Blvd., Irvine, CA 92718. (800) 457-7777; in Calif., (714) 583-3000. *Circle 15.*

1-2-4 memory board. Expands the storage of Hewlett-Packard Series II Laserjet printers by one, two, or four megabytes. The board has sockets to accept 256-kilobit or 1-megabit memory chips (chips not included) and plugs into the printer's memory-expansion slot. \$395 to \$1,595. Pacific Data Products Inc., 8525 Arjons Dr., Suite M, San Diego, CA 92126. (619) 549-0922. *Circle 16.*

2400PS internal modem. This Hayes-compatible card communicates at 2,400, 1,200, or 300 bits/second. It plugs into an expansion slot in IBM PS/2 Model 50, 60, and 80 computers. Automatic functions include answering, dialing, redialing, and transmission-speed detection. Includes Anchor-Talk software, which allows multi-tasking under the OS/2 operating system. \$349. Anchor Automation Inc., 20675 Bahama St., Chatsworth, CA 91311. (818) 998-6100. *Circle 17.*

3308/S laser printer. Produces eight pages/minute of text and graphics at resolutions to 90,000 dots per square inch. Made to handle 6,000 pages/month; toner cartridge prints 4,000 pages. Two paper trays hold 200 sheets each. \$10,950. Imagen Corp., Box 58101, Santa Clara, CA 95052. (408) 986-9400. *Circle 18.*

4/20 and 4/21 dot-matrix printers. Two models with 20 typefaces; both print 200 characters/second in draft mode and 40 characters/second in letter-quality mode. The 4/20 handles 80 columns. The 4/21 accepts 136 columns to accommodate spreadsheets and other wide documents. Both models emulate the IBM Graphics Printer and the Epson FX-80. \$645 and \$899. Honeywell Bull Inc., 300 Concord Rd., Billerica, MA 01821. (617) 671-2517. *Circle 19.*

Accelerator 25 processor card. This plug-in card equips the Macintosh SE personal computer for engineering and graphic design, desktop publishing, and data processing. The 25-megahertz card has a 68020 processor and works with Microsoft Excel and Word, VersaCAD, Adobe Illustrator, and Aldus PageMaker software. Less than \$2,000. Radius Inc., 404 E. Plumeria Dr., San Jose, CA 95134. (408) 434-1010. *Circle 20.*

HiRez mouse. Offers 320-dot/inch resolution to work with high-resolution monitors used in desktop publishing. The device needs 62 percent less desk space than a standard mouse, according to its maker. \$149. Logitech, 6505 Kaiser Dr., Fremont, CA 94555. (415) 795-8500. *Circle 21.*

Laser System 60 printer. Delivers full-page, high-resolution graphics and text at six pages/minute. Offers 31 standard typefaces, plus optional cartridge fonts. The printer accepts paper of various sizes and

weights and can print on transparency film and labels. \$2,195. PC's Limited, 9505 Arbo-retum Blvd., Austin, TX 78759. (512) 338-4400. *Circle 22.*

MacTape/SCSI tape drive. A nine-track drive that lets Macintosh Plus/SE/II personal computers read and write magnetic tape through a SCSI port. The device handles 800, 1,600, 3,200, or 6,250 bits/inch. \$7,695. Black-hole Technology Inc., 225 East St., Winchester, MA 01890. (800) 227-1688; in Mass., (617) 721-7690. *Circle 23.*

NuVista videographics card. Equips a Macintosh II to display and capture video images. The card has a 32-bit graphics processor and works with Macintosh II software (previous versions work with IBM-compatible computers). \$5,995 for a four-megabyte version, \$4,250 for a two-megabyte version. Truevision Inc., 7351 Shadeland Station, Indianapolis, IN 46256. (800) 858-8783; in Ind., (317) 841-0332. *Circle 24.*

NWS-841 workstation. This 32-bit machine has two processors to handle multiple tasks. Its eight-megabyte random-access memory expands to 16 megabytes. Also offers a 286-megabyte hard disk, a 3½-inch disk drive, six input/output ports, and a keyboard/mouse interface. \$19,900. Sony Microsystems Co., 1003 Elwell Court, Palo Alto, CA 94303. (415) 965-4492. *Circle 25.*

PSC-28 color monitor. A 12-inch analog monitor compatible with the IBM PS/2 VGA and MDGA standards. Resolution is 770×570 pixels. The monitor offers an unlimited number of colors and has a tilt-and-swivel stand. \$695. Princeton Graphic Systems, 601 Ewing St., Building A, Princeton, NJ 08540. (800) 221-1490; in N.J., (609) 683-1660. *Circle 26.*

Rembrandt I graphics board. Lets a Macintosh II display 256 colors at once. The board offers resolutions as fine as 1,024×768 pixels for a full-page display on a 15- or 19-inch monitor. Supports one-bit monochrome and eight-bit color modes in all resolutions; works with QuickDraw, Apple's graphics interface. \$995. Jasmine Technologies Inc., 555 De Haro St., San Francisco, CA 94107. (415) 621-4339. *Circle 27.*

Rival 386 personal computer. Built around an 80386 processor running at 10 or 20 megahertz. Includes two megabytes of random-access memory that expands to 16 megabytes; also offers eight expansion slots, a 5¼-inch floppy-disk drive, two parallel and two serial ports, and a 14-inch monochrome monitor. \$4,395. Arche Technologies Inc., 745 High St., Westwood, MA 02090. (800) 422-4674; in Mass., (617) 461-1111. *Circle 28.*

System 200 personal computer. Runs at 12.5 megahertz with an 80286 processor. The system has 640 kilobytes of random-

access memory, a 20-megabyte hard disk, an Enhanced Graphics Adapter monitor, a choice of 5¼- or 3½-inch floppy-disk drives, plus one parallel and two serial ports. Includes a 12-month Honeywell Bull service contract. \$2,299. PC's Limited, 9505 Arbo-retum Blvd., Austin, TX 78759. (512) 338-4400. *Circle 29.*

Sound Accelerator processor card. Provides compact-disc-quality playback of sounds from Macintosh-II and SE personal computers. The digital-signal-processing card permits sound processing and synthesis in real time. \$995. Digidesign Inc., 1360 Willow Rd., Suite 101, Menlo Park, CA 94025. (415) 327-8811. *Circle 30.*

Tote-A-Modem modem. This Hayes-compatible device fits in a shirt pocket or briefcase. The battery-operated modem offers automatic dialing and answering and stores 20 commands. It works with asynchronous computers that have an RS-232C serial port. \$199 for the 1,200-bit/second model; \$359 for the 2,400-bit/second version. Black Box Corp., Box 12800, Pittsburgh, PA 15241. (412) 746-5500. *Circle 31.*

COMPUTER SOFTWARE

101 Tips, Tricks & Traps for 1-2-3. Provides a pop-up screen in Lotus 1-2-3 to answer questions, explain shortcuts, and give hints for using the spreadsheet program. Users can add their own tips. \$69.95. Macro-pac International, 19855 Stevens Creek Blvd., Suite 168, Cupertino, CA 95014. (800) 624-0077; in Calif., (408) 996-8143. *Circle 32.*

Accpac Easy accounting system. A two-part package: A general-accounting program tracks customers, vendors, and account numbers. A second program handles payrolls for salaried, hourly, and commissioned employees (including weekly, biweekly, semimonthly, and monthly pay periods) and prints paychecks and W-2 forms. These programs work separately or together on IBM-compatible computers with a 320-kilobyte memory running DOS 2.0 or later versions. \$89 each. Computer Associates International Inc., 2195 Fortune Dr., San Jose, CA 95131. (408) 432-1727. *Circle 33.*

ACT contact manager. Version 1.1 helps maintain databases of names and addresses and also performs word processing. Organizes and files phone numbers, activities, and expense records, printing reports and reminding people of appointments. Performs automatic dialing with a Hayes-compatible modem and works with IBM-compatible computers with 460 kilobytes of memory running DOS 2.0 or later versions. \$49.95. Conductor Software Inc., 9208 W. Royal Lane, Irving, TX 75039. (214) 929-4749. *Circle 34.*

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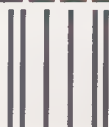
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BeckerText ST word processor. Lets Atari users add graphics to text; performs automatic hyphenation and numeric calculations. The program's spelling checker has an expandable dictionary. \$99.95. Abacus, 5370 52nd St. S.E., Grand Rapids, MI 49508. (616) 698-0330. *Circle 35.*

Collector's Edition graphics library. Offers hundreds of graphic shapes for use with the Adobe Illustrator and Illustrator 88 desktop-publishing packages. Also provides medium-weight serif and sans-serif typefaces that can be modified. \$125. Adobe Systems Inc., Box 7900, Mountain View, CA 94039. (415) 961-4400. *Circle 36.*

Context search program. Searches through electronic text in computer networks running MS-DOS or Unix. The program looks in ASCII, C-source, and formatted word-processing files and runs on an IBM PC/AT under both DOS and SCO Xenix. (Other versions work with VAX minicomputers and Sun 3 and Hewlett-Packard workstations.) \$495 to \$5,995. Laticorp Inc., 185 Berry St., San Francisco, CA 94107. (415) 543-1199. *Circle 37.*

Draw Applause graphics program. Helps create charts, special effects, and other images for business presentations. Sends finished work to laser printers, plotters, and

film recorders. The software runs on the IBM PC/AT/XT, PS/2, and compatible computers; requires an EGA board and 128 kilobytes of memory, plus a mouse. \$495. Ashton-Tate, 20101 Hamilton Ave., Torrance, CA 90502. (213) 329-8000. *Circle 38.*

Ermasoft envelope printer. Lets laser printers handle envelopes. The program, called Laser Envelopes 2.0, simulates an envelope on screen and can print a return address; it runs on IBM-compatible personal computers using Hewlett-Packard LaserJet or compatible printers. \$39.95. E.R.M. Associates, Box 1032, Agoura Hills, CA 91301. (818) 707-3818. *Circle 39.*

Eureka math-problem solver. This Apple Macintosh program calculates equations in business, economics, engineering, and other disciplines. \$195. Borland International Inc., 4585 Scotts Valley Dr., Scotts Valley, CA 95066. (408) 438-8400. *Circle 40.*

Instant Pages desktop publisher. Prints ASCII word-processing files; offers word wrapping and creates lines and boxes. The package accepts keyboard or mouse commands and does not need a graphics card. Works with color or monochrome monitors on IBM-compatible computers. \$49.95. Electronic Arts, 1820 Gateway Dr., San Mateo, CA 94404. (415) 571-7171. *Circle 41.*

Omnis Quartz relational database. Made for systems that use Microsoft Windows and IBM's Presentation Manager interface. The database easily accommodates additional users and holds 2.5 gigabytes of data. \$795 (includes Windows). Blyth Software Inc., 1065 E. Hillsdale Blvd., Foster City, CA 94404. (415) 571-0222. *Circle 42.*

Report Writer program. Creates custom reports, forms, and business graphics on computers using Unix, Xenix, or Ultrix operating systems. Reads and writes files from Lotus 1-2-3, dBase, Wordstar, Basic, ASCII, and Cobol programs. \$995 for Xenix, \$1,195 for Unix, \$1,295 for Ultrix. Snow Software, 2360 Congress Ave., Clearwater, FL 34621. (813) 784-8899. *Circle 43.*

Simply Accounting package. Integrates various accounting tasks on one disk, including payroll, general ledger, accounts payable/receivable, inventory, business forms, and job-cost systems. Runs on Macintosh personal computers with one megabyte of random-access memory, 800 kilobytes of on-line storage, and 128 kilobytes of read-only memory. \$449. Bedford Software Corp., 15311 N.E. 90th St., Redmond, WA 98052. (206) 883-0074. *Circle 44.*

StreetSmart map database. Accepts information such as distances, one-way

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streets, block addresses, speed limits, compass directions, and intersections, then calculates the best route to a destination and prints out directions. Requires an IBM PC, PS/2, or compatible computer. \$89. Street Map Software, 1014 Boston Circle, Schaumburg, IL 60193. (312) 529-4044. *Circle 45.*

TaxView income-tax aid. Generates an IRS-approved 1040 tax form. Runs on IBM-compatible computers under Microsoft Windows (a previous version works with Macintosh computers). \$119 for the federal-tax program; yearly upgrades cost \$55. State-tax programs are \$65, with a \$35 yearly upgrade. Softview Inc., 4820 Adohr Lane, Camarillo, CA 93010. (805) 388-2626. *Circle 46.*

Terrific chart maker. Helps managers design and produce business-organization charts. Works with IBM-compatible personal computers and any printer, but charts look best on Hewlett-Packard LaserJet-compatible printers or dot-matrix printers. \$59.95. KD Systems Inc., Box 97024, Raleigh, NC 27624. (919) 847-8838. *Circle 47.*

Who/What/When time manager. Keeps track of assignments, appointments, and projects, ranking tasks by priority. The program has a time-bar display for scheduling and flags conflicting events. Includes a calculator and an automatic dialer. \$189.95. Chronos Corp., 1500 16th St., San Francisco, CA 94103. (415) 626-4244. *Circle 48.*

■ COMMERCIAL/INDUSTRIAL



Fiber Flex sensor mount. Keeps fiber-optic scanner tips in position. The mount's segments swell and seal in wet environments, and it survives shocks and vibration. Available only as a factory-assembled option—6- and 9-inch versions add \$26 to the price of cable; 12-inch models add \$30. Eaton Corp., Cutler-Hammer Products, 4201 N. 27th St., Milwaukee, WI 53216. (800) 558-5488; in Wis., (414) 449-6000. *Circle 49.*

Bar Code data-entry module. Collects information on the shop floor regarding attendance and labor-related activities. Connects as many as 32 data-entry terminals through serial ports. The product comes as a desktop, benchtop, or wall-mounted unit. \$12,000 for a four-terminal system. ProfitKey International Inc., 382 Main St., Salem, NH 03079. (603) 898-9800. *Circle 50.*

BVD-600 laser-beam viewer. Evaluates and converts ultraviolet or soft X-ray radiation into a visible image, showing hot spots, fine structure, and beam shape. The viewer's aperture accommodates beams as large as 35 mm in diameter. \$850. Taunton Technologies Inc., 631 Main St., Monroe, CT 06468. (203) 261-4708. *Circle 51.*

Graphic Data Center Manager. This computer-aided drawing system and database helps manage computer-room space and equipment. The package determines power and cooling requirements for layout plans and includes an on-line tutorial program, a graphics database, and a query function. Also records equipment information for inventory and billing. \$4,000 to \$7,500. Graphic Management Group Inc., 274 White Plains Rd., Eastchester, NY 10707. (800) 346-6828; in N.Y., (914) 793-8338. *Circle 52.*

Hipac Protein A columns. These chromatograph columns purify antibodies and other proteins, tolerating acidic and basic environments without leaching. A proprietary silica support eliminates nonspecific binding. Available in several sizes. \$475 to \$5,000. ChromatoChem Inc., 2837 Fort Missoula Rd., Missoula, MT 59801. (800) 426-7227; in Mont., (406) 728-5897. *Circle 53.*

L-6000 HPLC pump. Delivers solvent for chromatography. The self-priming pump offers flow rates from 1 to 30 microliters/minute. \$4,490. EM Science, 111 Woodcrest Rd., Cherry Hill, NJ 08034. (800) 222-0342; in N.J., (609) 354-9200. *Circle 54.*

MGI/CADD 3 design system. A 2-D program with eight symbol libraries for creating schematic drawings. The libraries include electronic, logic, space-planning, flowchart, hydraulic/pneumatic, and piping/instrumentation symbols. Users can create their own libraries and add to existing ones. The software runs on IBM-compatible computers. \$1,495. Microcomputer Graphics Inc., 13468 Washington Blvd., Marina Del Rey, CA 90292. (213) 822-5258. *Circle 55.*

MSC/mod graphics modeler. Lets engineers analyze a structure's reaction to stress, vibration, pressure, and temperature without building a prototype. Accepts drawings from computer-aided-design files; allows 2-D and 3-D meshing, rotating, mirroring, and sweeping. Works on a personal computer or mainframe. \$495. MacNeal-Schwendler Corp., 815 Colorado Blvd., Los Angeles, CA 90041. (213) 258-9111. *Circle 56.*

P6000L bar-code-label printers. Four models print forms and bar codes as well as text and logos. All the printers offer bold-face, underlining, subscripts, and superscripts. One model prints 1,880 labels per hour. \$5,620 for a 400-line/minute model; \$7,585 for an 800-line/minute version. Printronix Inc., Box 19559, Irvine, CA 92713. (714) 863-1900. *Circle 57.*

PM 2525 digital multimeter. A 4½-digit unit made by Philips; performs 18 measurements, including ac/dc volts and amps, two- and four-wire resistance, temperature, and time. Has five voltage, eight current, and seven resistance ranges. \$795. John Fluke Manufacturing Co. Inc., Box C9090, Everett, WA 98206. (800) 426-0361; in Wash., (206) 347-6100. *Circle 58.*

Pro-Matlab computation software. Performs mathematic and signal-processing calculations on Apollo workstations. The program, written in C, uses a matrix and offers color graphics. Previous versions run on Sun, VAX, and IBM-compatible computers. \$4,500 to \$6,000. Math Works Inc., 20 N. Main St., Suite 250, Sherborn, MA 01770. (617) 653-1415. *Circle 59.*

RFI-shielded panel light. This light-emitting diode suppresses radio-wave interference of two gigahertz. The 0.312-inch-diameter device has an anodized aluminum sleeve and comes in four colors. \$18 each in lots of 1,000. Data Display Products, 445 S. Douglas St., El Segundo, CA 90245. (800) 421-6815; in Calif., (213) 640-0442. *Circle 60.*

SBA-8 SCSI-to-SBX adapter. Converts a SCSI storage bus to an input/output backplane for industrial controllers, including analog-to-digital and digital-to-analog converters and digital signal processors. The adapter provides a dedicated channel, leaving the system bus free for memory and direct-memory-access transfers. Compatible with the SBX bus. \$480. Innovative Ideas and Technologies Inc., 5090 Central Highway, Suite 6, Pennsauken, NJ 08109. (609) 486-0168. *Circle 61.*

Silink data-acquisition software. Gathers data from factory equipment for processing by Lotus 1-2-3 or other ASCII programs on IBM-compatible personal computers. The program presents data as ladder diagrams, statement lists, and control-system flowcharts. Works in local-area networks with as many as 30 computers. \$4,995. Siemens Energy & Automation Inc., Programmable Controls Division, 10 Technology Dr., Centennial Park, Peabody, MA 01960. (617) 532-6720. *Circle 62.*

Soft Master/Redline design software. An interactive graphics package that displays and manipulates mainframe-based Cadam drawings on IBM 3270 terminals or IBM PC workstations. Lets designers draw lines around areas to be changed and add

comments. Notations are stored in a new layer, leaving the original drawing unchanged. \$25,000 per mainframe (supports any number of terminals). Integrated Graphics Systems, 1300 Chelton, S. Pasadena, CA 91030. (818) 799-4128. *Circle 63.*

Spectrochart-PC analysis software. Records and analyzes voltage signals from the recorder output of a spectrometer; automatically handles as many as 100 samples. The program displays or prints results graphically and numerically. Works with IBM-compatible computers. \$595. Interactive Microware Inc., Box 139, State College, PA 16804. (814) 238-8294. *Circle 64.*

Ultrasonik cleaners. Using sound waves, these devices clean glassware, instruments, and equipment. Various models offer interchangeable tanks, controllers, and accessories. \$200 to \$885. J.M. Ney Co., Neytech Division, Bloomfield, CT 06002. (203) 242-2281. *Circle 65.*

■ MANUFACTURING SUPPLIES

DataSweep 1 scanner package. This attachment enters typed or computer-printed information into an IBM PC/XT/AT or compatible computer. The device handles 120 words/minute and works with most word-processing, spreadsheet, database, and desktop-publishing programs. The package includes a hand-held reader, an interface board, and software. \$625 each in lots of 1,000. Soricon Corp., 4725 Walnut St., Boulder, CO 80301. (303) 442-2800. *Circle 66.*

Frequency synthesizer chip. Converts high frequencies to low for satellite TV systems using outdoor or head-end satellite dishes. Covers 300 megahertz to 2.3 gigahertz; comes in a 14-lead ceramic package. \$7 each in lots of 1,000. Plessey Semiconductors, 9 Parker, Irvine CA 92718. (714) 472-0303. *Circle 67.*

LDM 1550/1551 laser diode modules. Model 1550 includes laser, thermistor, and monitor diodes in an eight-pin package. Model 1551 offers an extended operating temperature of more than 110°C and comes in a 14-pin package. Both units are hermetically sealed. \$2,195. Tektronix Inc., Box 500, Beaverton, OR 97077. (503) 627-4220. *Circle 68.*

MD640.400 display. An electroluminescent display for high-end personal computers, instruments, factory terminals, and process controllers. It handles 25 lines of 80 characters; for graphics, it has square pixels on a 12-mil pitch. The display is only 18.3 mm deep, including connector. \$12.50; \$7.37 each in lots of 100. Finlux Inc., 20395 Pacifica Dr., Suite 109, Cupertino, CA 95014. (408) 725-1972. *Circle 69.*

■ CONSUMER PRODUCTS



ViewMax TV/VCR. Model KMV-9012 combines a VHS videocassette recorder and a 19-inch color television. Has an eight-event, 14-day timer and a 110-channel, cable-compatible electronic tuner. \$699. Goldstar Electronics International Inc., 1050 Wall St. West, Lyndhurst, NJ 07071. (201) 460-8870. *Circle 70.*

3350 cordless telephone. Automatically finds the clearest transmission channel; stores 10 numbers and offers one-touch redialing, an in-use indicator, and a two-way intercom and paging system. \$154.95. GTE

Consumer Communications Products Corp., 1 Stamford Forum, Stamford, CT 06904. (203) 965-2000. *Circle 71.*

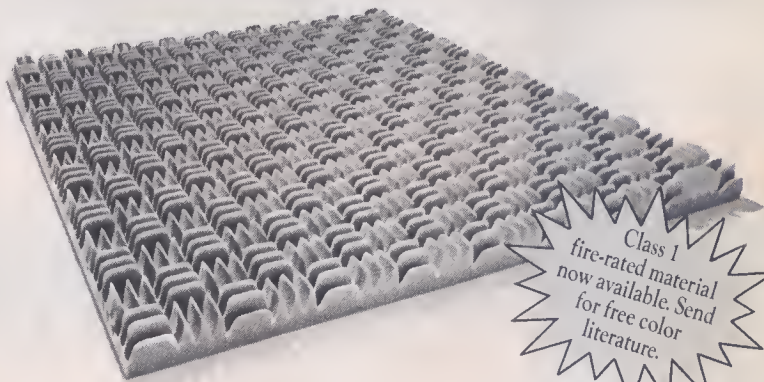
3-D CAM camcorder. Makes home movies in 3-D, watched through glasses connected to an electrical adapter. \$2,850. Toshiba America Inc., 82 Totowa Rd., Wayne, NJ 07470. (201) 628-8000. *Circle 72.*

M-4285 two-picture VCR. This VHS videocassette recorder creates a window in the screen to let viewers watch television while playing a videotape. The smaller picture appears in any corner of the screen. \$579.95. Toshiba America, 82 Totowa Rd., Wayne, NJ 07470. (201) 628-8000. *Circle 73.*

NS-A90/95 speakers. Wall-mounted units made to carry the rear channels for surround-sound audio and video systems. The four-pound speakers measure 9×9×3½ inches and handle 30 watts. \$69.95 per pair. Yamaha Electronics Corp., 6660 Orangethorpe Ave., Buena Park, CA 90620. (714) 522-9105. *Circle 74.*

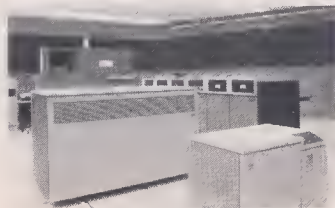
SK315 compact-disc cleaner. Resembles a compact-disc player; cleans a disc in about 40 seconds. Comes with cleaning fluid. \$60. Signet, 4701 Hudson Dr., Stow, OH 44224. (216) 688-9400. *Circle 75.*

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COMPANY PROFILES/ INTERVIEWS

- ☐ 3-D Systems
- ☐ Aion
- ☐ Alcoa
- ☐ AT&T
- ☐ Cheyenne Software
- ☐ Clinitherm
- ☐ CMQ
- ☐ Digital Equipment
- ☐ Endogen
- ☐ GM
- ☐ GTX
- ☐ Healthdyne
- ☐ LISSA
- ☐ Lockheed
- ☐ Mathsoft
- ☐ Mentor Graphics
- ☐ Microvideo Learning Systems
- ☐ Odetics
- ☐ Presidential Adviser William Graham
- ☐ Prime
- ☐ Siemens Capital
- ☐ TRW
- ☐ Voyager
- ☐ Xerox

COMPUTERS

- ☐ Apple's Corporate Image
- ☐ A Rise in No-Fault Systems
- ☐ CAD/CAM's \$800-Million Winners
- ☐ Chip Takeover Targets
- ☐ Compact-Disc Companies Test New Frontier
- ☐ Computers Invade the Executive Suite
- ☐ Designware Leader Faces New Threat
- ☐ Fax Makers Target Low-End Market
- ☐ Laptops' Portable Power
- ☐ Looking Good on Paper
- ☐ Office Standards Relax
- ☐ Picking the New Standard
- ☐ The Desktop Publishing Fad
- ☐ The Newest Microcomputers: Strategies For Macintosh Owners
- ☐ The Return of Outside Data Processing
- ☐ Rethinking the Mainframe

- ☐ Survival Strategies: Chip Companies Shift Gears
- ☐ Workstation Wars: Battle of the Big 7

CONSUMER

- ☐ Camcorder Companies Divvy Up a Bewildered Market
- ☐ Can Small Companies Succeed?
- ☐ Home, Safe, Home
- ☐ IBM Dpens the Door for Entrepreneurs
- ☐ Interactive TV Opens New Retail Market
- ☐ Money Machines Outgrow Banking
- ☐ More Schooling for Tomorrow's Engineers?
- ☐ New Pagers Put a Mailbox in Your Pocket
- ☐ Office Aids for Executives
- ☐ Smart Cards Get Smarter
- ☐ TV: The Push for a Sharper Picture

INDUSTRIAL

- ☐ 1988's Hottest Superconducting Companies
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- ☐ Big Hopes for Small Dishes
- ☐ Biotech Targets Fight Back
- ☐ Cash Crisis Creates Biotech Alliances
- ☐ Companies Cash In on Soviet Technology
- ☐ Companies Profit from Sounds of Silence
- ☐ Companies Turn Ideas Into Profits
- ☐ Dawn of the Biotech Farm
- ☐ France Plays Catch-Up in Biotech Market
- ☐ Industrial Adhesives Start to Spread
- ☐ Laser Radar Comes Out of the Lab
- ☐ New Filters Clean Up in New Markets
- ☐ New Water System Cuts Filtering Cost
- ☐ Optical Memories Vie for Data Storage
- ☐ Phone Companies Argue Over New Standards
- ☐ Phone Companies Gamble On Technology
- ☐ Scanner Standards: Who Will Emerge?
- ☐ Superconductor Race Accelerates
- ☐ The Rewiring of America
- ☐ U.S. Robot Makers Try to Bounce Back
- ☐ Where Venture Capital Is Investing Now

JAPAN WATCH

- ☐ A New Look in Mainframes

- ☐ Assembly Lines Build Ideas
- ☐ Memory For Microwaves
- ☐ New Uses for Digital Tape
- ☐ Photos Go Electronic
- ☐ Prefab Houses Move Upscale
- ☐ The Language Advantage
- ☐ The Superconducting Sprint

MEDICAL

- ☐ AIDS Crisis Spurs Hunt for New Tests
- ☐ Better Drug Packaging Thwarts Saboteurs
- ☐ Biotech Firms Cultivate Cell Market
- ☐ Building a Better Bite
- ☐ Card Monitors X-Ray Exposure
- ☐ CT Scanners Seek Out Manufacturing Flaws
- ☐ Harvesting the Cell
- ☐ Herpes DNA Probe Is Nonradioactive
- ☐ Medical Pumps: Smaller and More Efficient
- ☐ The Race After Genentech

MILITARY/AEROSPACE

- ☐ Ceramic Turbines for Cars Could Wind Up on Planes
- ☐ Equipment Makers Profit from Safer Space
- ☐ Little Giants Win Space-Plane Contracts
- ☐ Military Software's New Market
- ☐ Mini TV Cameras Send Images from Inner Space
- ☐ Air Reservations: New Savvy in the Skies
- ☐ Pentagon Program Seeks Advanced Analog Chips
- ☐ Pentagon Sees Infrared
- ☐ The Venerable Airship Bounces Back
- ☐ Space Station Business
- ☐ Star Wars: Where the Money's Going

THE LAW

- ☐ Competitors Team Up
- ☐ Data Access Cost May Rise
- ☐ Investors Gain Clout
- ☐ Let the Buyer Beware
- ☐ 'Look and Feel' Lawsuits
- ☐ Patents Safeguard Software
- ☐ Patents Vs. Public Interest
- ☐ The Startup Insurance Trap

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MARKETWATCH

NEW COMPANIES

COMPANY	BUSINESS OBJECTIVE	FINANCING	OFFICERS	OFFICERS' PREVIOUS POSTS
Harris Data Services 1201 East Adington Alexandria, VA 22314 (703) 739-1885	To develop software systems and provide software support to the federal government and its prime contractors.	Wholly owned subsidiary of Harris Corp.	Paul Patch, president	Harris, Government Information Systems Div., v.p. software operations
Harris Technical Services 1201 East Adington Alexandria, VA 22314 (703) 739-1990	To repair and maintain electronic equipment for the government and related industries; a business unit will manage facilities and provide training.	Wholly owned subsidiary of Harris Corp.	Joseph Borth, president	Harris, Government Support Systems, v.p. (current)
Iris Fiber Optics 40 Nagog Park Acton, MA 01720 (617) 635-9400	To produce infrared-transmitting optical fibers and develop fiber-optic systems for process-control equipment, medical and scientific instruments, and the defense industry.	Over \$1 million from Bessemer Partners, Galileo Electro-Optics	James Furneaux, chairman William Stevenson, president	Bessemer Partners, partner Consultant
Masterplay Publishing 8417 Sun State St. Tampa, FL 33614 (813) 888-7773	To create, manufacture, and market entertainment software for personal computers.	\$700,000 in private funds	Andrew Greenberg, president Michael Mossimillo, executive v.p.	Andrew Greenberg Inc., president (current) Bolt Beronick & Newmon, sr. engineer
Monitor Technology 2779 Hortland Rd. Falls Church, VA 22043 (703) 698-5520	To develop a digital monitoring system that detects faults in machinery.	\$500,000 in first-round financing	Walter Hernandez, president Ed Page, v.p.	Ensco, division director Ensco, division director
Octel Communications 890 Tosman Or. Milpitas, CA 95035 (408) 942-6500	To design, manufacture, and market voice-processing systems for telecommunications.	\$13.7 million from initial public offering (NASDAQ:OCTL)	Robert Cohn, president, CEO Peter Olson, executive v.p.	Acurex, marketing manager PPO Designs, consultant
Rainbow Images 181 Metro Dr. San Jose, CA 95110 (408) 971-7600	To distribute Explore 3D modeling software for computer simulation and animation.	Undisclosed funding from founder	Richard L. Newsome, president, founder	Sysgen, executive v.p.
Sony Microsystems 1003 Elwell Court Palo Alto, CA 94303 (415) 965-4492	To market News, a series of Unix-based engineering workstations.	Wholly owned subsidiary of Sony Corp. of America	Masohiro Morimoto, president	Sony Information Products Div., v.p. product planning
Transition Technology 111 Main St. Amesbury, MA 01913 (617) 388-7122	To manufacture and market intelligent input/output devices for the factory and process-control market.	\$3 million in first-round funds from 3i Ventures	Walter Bennett, president, CEO founder Albert Libby, exec. v.p.	Analogic Corp., engineering manager Analogic Corp., chief engineer
Vitalink Communications 6607 Kaiser Dr. Fremont, CA 94555 (415) 794-1100	To design, build, and sell data-communications products that connect geographically dispersed local-area networks over common-carrier transmission lines.	\$16 million from initial public offering (NASDAQ:VITA)	George Archuleta, president, CEO	Vitalink, v.p. sales and marketing
Xercon Expert Systems 16505 Saint Helier St. Houston, TX 77040 (713) 937-9321	To provide consulting services to users of the 1st Class expert-system development program made by First Class Expert Systems.	Undisclosed funds from parent company, Xercon Offshore Intl.	Bill Windle, president, founder	Xercon Offshore International, president

CONTRACTS AWARDED

AWARDED TO	AWARDED BY	AMOUNT	PURPOSE
Abiomed Cherry Hill Dr. Danvers, MA 01923 (617) 777-5410	National Heart, Lung, and Blood Institute	\$5.6 million	To develop a battery-powered, implantable artificial heart, working with the Texas Heart Institute.
Alcatel Network Systems 3128 Smoketree Ct. Raleigh, NC 27604 (919) 850-6001	Shell Oil	20 million French francs (about \$3.5 million)	To install a system to provide worldwide communication links for an oil field.
Arthur D. Little 28 Acorn Park Cambridge, MA 02140 (617) 864-5770	U.S. Department of Energy	\$14 million	To develop a coal-burning diesel engine.
Beech Aircraft Box 85 Wichita, KS 67201 (316) 681-7792	U.S. Air Force	Not disclosed	To design and build composite landing-gear doors for the C-17 jet transport.
Boeing Aerospace Box 3999 Seattle, WA 98124 (206) 773-2816	U.S. Air Force	\$3.5 million	To conduct research and development on carbon-carbon composite materials for hypersonic vehicle structures designed to operate at high temperatures.
Ceramics Process Systems 840 Memorial Dr. Cambridge, MA 02139 (617) 354-2020	Defense Advanced Research Projects Agency (DARPA)	\$6 million	To continue development of ceramic-based superconducting wire.
Computer Sciences 2100 E. Grand Ave. El Segundo, CA 90245 (213) 615-0311	U.S. Air Force Flight Test Center, Edwards Air Force Base	\$278 million	To provide engineering and technical services at the Edwards Flight Test Range and the Utah Test & Training Range.
GTE Data Services Box 1548 Tampa, FL 33601 (813) 224-8093	State of Missouri	\$15.5 million	To operate a Medicaid system that will handle claims processing, administration, systems development, telecommunications, and recipient relations.
Laboratory Resources 363 Old Hook Rd. Westwood, NJ 07675 (201) 666-6644	U.S. Environmental Protection Agency	\$250,000	To perform chemical analysis for multi-media, multi- concentration metals and inorganics.
Metier Monogement Systems 2900 North Loop West Houston, TX 77092 (713) 956-7511	Arthur D. Little	Not disclosed	To provide 60 copies each of Artemis 2000, a language- and database-management system, and Artemis Link, communications software for sending data from personal computers to Artemis mainframes.
Paromex Electronics 8201 Greensboro Dr. McLean, VA 22102 (703) 847-3346	Government of Canada	\$950 million	To design, test, and install electronic and combat systems on a second set of six Canadian Patrol Frigates.
Peak Systems 3550 W. Warren Ave. Fremont, CA 94538 (415) 657-5900	U.S. Air Force	\$500,000	To develop a substrate for high-temperature semiconductor devices, under a Small Business Innovative Research (SBIR) contract.
Perceptics 725 Pellissippi Pkwy. Knoxville, TN 37933 (615) 966-9200	University of South Carolina	\$3.3 million	To supply a Gemini supercomputer to support research and engineering.

■ MARKETWATCH ■

AWARDED TO	AWARDED BY	AMOUNT	PURPOSE
Pixar 3240 Kerner Blvd. San Rafael, CA 94901 (415) 258-8100	Phillips Medical Systems	\$5 million (first year)	To provide a medical system for 3-D volumetric reconstruction of computed-tomography (CT) scans.
Poseidon Systems 1898 S. Flotiron Ct. Boulder, CO 80301 (303) 449-4999	NBI	Not disclosed	To develop a training program called <i>Learning MS-DOS</i> on interactive videodiscs.
Solarex 826 Newtown-Yordley Rd. Newtown, PA 18940 (301) 948-0202	Sondio Labs	Not disclosed	To develop a high-efficiency silicon concentrator solar cell.
Teknowledge Federal Systems 501 Main St. Marin, CA 91360 (805) 495-8265	Lockheed Aeronautical Systems, Georgia Division	\$1.2-million subcontract	To define hardware and software requirements for achieving real-time performance in the Lockheed Pilot's Associate system.
Thermedics Box 2999 Woburn, MA 01888 (617) 622-1111	Thermo Electron	\$4 million	To develop and commercialize Thermedics' cocaine and heroin detector and help develop its Egis explosives detector.
Thermedics Box 2999 Woburn, MA 01888 (617) 622-1111	U.S. Army	\$1.1 million	To develop a medicated wound dressing that forms a watertight barrier and fights infection.
Unicorn Video Productions 639 Granite St. Braintree, MA 021B4 (617) B49-0950	SoftVision	\$3.4 million	To produce 60 training videos for microcomputer software.
Unisys 8201 Greensboro Dr. McLean, VA 22102 (703) 847-3346	U.S. Department of Transportation	\$40 million	To provide data-processing support services.
Unisys Box 500 Blue Bell, PA 19424 (215) 542-4213	Transmediterranea	\$2.2 million	To develop and implement the Sireno real-time reservation system for Transmediterranea, a cruise-ship company.
Unisys Defense Systems 8201 Greensboro Dr. McLean, VA 22102 (703) B47-3346	U.S. Army Information Systems Command	\$65.7 million	To provide automation-support services for data processing.
Unisys Defense Systems 8201 Greensboro Dr. McLean, VA 22102 (703) B47-3346	National Oceanic and Atmospheric Administration	\$450 million	To produce the first units of a nationwide radar-based weather-detection and information network.
Utility Graphics Consultants 6200 S. Syracuse Way Englewood, CO 80111 (303) 773-6166	Indianapolis Department of Metropolitan Development	Not disclosed	To develop a plan to integrate the department's Geographic Information System requirements into the Indianapolis Mapping & Geographic Information System.
Valsan Partners 1 Horatio St., Jackson Sq. New York, NY 10014 (212) 807-6622	Electro Aviation	Not disclosed	To replace the engines on the B-727 aircraft and reconfigure the cockpit for two pilots.
Wyle Laboratories 12B Maryland St. El Segundo, CA 90245 (213) 678-4251	TRW Electronics & Defense Sector	\$21 million	To build and design a turnkey acoustic-test facility at Spoce Park in Redondo Beach, California.

MERGERS

COMPANY	BUSINESS	COMPANY	BUSINESS	NEW NAME
Edgar, Dunn & Canaver 847 Sansome St. San Francisco, CA 94111 (415) 397-5858	Performs management consulting	New Venture Consultants 1717 Embarcadero Rd. Palo Alto, CA 94303 (415) 856-9800	Provides management consulting; specializes in growing high-technology companies	EDC/New Venture
VMX 17217 Waterview Pkwy. Dallas, TX 75252 (214) 907-3000	Licenses voice store-and-forward technology to communication-equipment makers	Opcom 110 Rose Orchard Way San Jose, CA 95134 (408) 943-0878	Supplies call-processing systems	VMX

ACQUISITIONS

BUYER	BUSINESS	COMPANY ACQUIRED	BUSINESS	AMOUNT
Amperif 9232 Eton Ave. Chatsworth, CA 91311 (818) 998-7666	Designs and builds mass-storage subsystems for mainframe computers	HDR Systems 8404 Indian Hills Dr. Omaha, NE 68114 (402) 399-1000	Develops relational-database software; consults for the federal government	Not disclosed
Crosfield Electronics Box 246 Minneapolis, MN 55440 (612) 895-3000	Electronic equipment for the pre-press industry	Dicomed 1200 Portland Ave. S. Minneapolis, MN 55440 (612) 895-3000	Designs, builds, markets, and supports computer-graphics products	\$12.7 million
CyCare Systems 4343 E. Camelback Rd. Phoenix, AZ 85018 (602) 952-5300	Information-processing services and systems for the health-care industry	Databill 13D1 Capitol of Texas Hwy. Austin, TX 78746 (512) 328-0888	Data-processing services and systems for small group medical practices	About \$12.5 million
Eastman Kodak 343 State St. Rochester, NY 14650 (716) 724-4000	Makes photographic supplies and equipment	Sterling Drug 90 Park Ave. New York, NY 10016 (212) 907-2D00	Produces pharmaceuticals, cleaners, cosmetics, and toiletries	\$5.1 billion
Prime Computer Prime Park Natick, MA 01760 (617) 655-8000	Makes super-minicomputers and software	Computervision 10D Crosby Dr. Bedford, MA 01730 (617) 275-1800	Produces computer-aided design and manufacturing systems	\$435 million
Recognition Equipment Box 66D204 Dallas, TX 75266 (214) 579-6D00	Provides data-capture and document-management systems	Compuscan's FormsReader business 81 Two Bridge Rd. Caldwell, NJ 070D6 (2D1) 575-D500	Designs, builds, and markets optical-character-recognition page scanners	About \$4 million
Star Technologies 515 Shaw Rd. Sterling, VA 22170 (703) 689-4400	Makes 32-bit array processors	GE's Graphicon products Box 13D49, Research Triangle Park, NC 27709 (919) 544-8120	Makes 3-D graphics processors	Not disclosed
Tandem Computers 19333 Valco Pkwy. Cupertino, CA 95014 (408) 725-6000	Manufactures computers for on-line transaction processing	Ungermann-Bass 39DD Freedom Circle Santa Clara, CA 95D52 (408) 496-0111	Makes local-area networks	\$26D million
Telxon 3330 W. Market St. Akron, OH 44313 (216) 687-3700	Makes portable micromputers	Real Time Computer Specialists 1D1 E. Miller St. Newark, NY 14513 (315) 331-3505	Creates communications and applications software	Not disclosed
Tracor 6500 Tracor Lane Austin, TX 78725 (512) 926-2800	Develops and produces defense electronics, analytical instruments, and electronic components	Ultron Labs 4423 Fortrain Ct. San Jose, CA 95134 (4D8) 945-8812	Designs and markets cryptographic data-security systems	Not disclosed

JOINT VENTURES

COMPANY	COMPANY	PURPOSE	CONTACT
B&W Fuel	Virginia Fuels (a consortium of the French companies Cogema, Framatome, and Uranium Pechiney)	To make nuclear fuel for a pressurized-water reactor and provide related products and services.	B&W Fuel 335 Old Forest Rd. Lynchburg, VA 24501 (804) 385-2000
Biotechnica International	F. Hoffmann-La Roche & Company (Basle, Switzerland)	To develop and manufacture a genetically engineered microorganism that produces efficient quantities of a vitamin.	Biotechnica 85 Bolton St. Cambridge, MA 02140 (617) 864-0040
Candela Laser	Mitsui & Company	To form Candela International, which will provide international distribution and customer service for Candela's laser systems and medical equipment from other manufacturers.	Candela Laser 530 Boston Post Rd. Wayland, MA 01778 (617) 358-7637
Cullinet Software	Banca de Bilbao and T&G International	To market and support Cullinet software products in Spain.	Cullinet Software 400 Blue Hill Or. Westwood, MA 02090 (617) 329-7700
Oata Group	Matarala	To develop communications software linking Matarala's KDT portable data terminal with Oata Group's Fieldwatch service-management information system.	Oata Group 77 S. Bedford St. Burlington, MA 01803 (617) 272-4100
Digital Equipment	Apple Computer	To integrate Macintosh personal computers and Apple Talk networks with Digital's VAX computers and DECnet/OSI enterprise networks.	Digital Equipment 146 Main St. Maynard, MA 01754 (800) 344-4825
Fidelity Communications	Merrill Lynch Teleport Technologies	To build and operate a fiber-optic network in Boston, Mass., that will carry large volumes of voice and data communications.	Teleport Communications 10 High St. Boston, MA 02110 (617) 292-0770
ICAD	British Maritime Technology	To develop a knowledge base for expert-system software to help automate shipbuilding.	ICAO 1000 Massachusetts Ave. Cambridge, MA 02138 (617) 868-2800
Microsoft	Ashtan-Tate	To create software that will manage databases on computer networks.	Microsoft 16011 N.E. 36th Way Redmond, WA 98052 (206) 882-8080
Pacific Gas & Electric	Bechtel Power	To develop privately owned electric-power plants for commercial facilities, developers, and other power buyers.	Pacific Gas & Electric 77 Beale St. San Francisco, CA 94106 (415) 972-7000
Polycell	Cetus	To research and produce an immunological agent that attacks specific cancer cells.	Polycell 320 Fisher Bldg. Detroit, MI 48202 (313) 873-0200
SmithKline Beckman	University of Cambridge School of Clinical Medicine	To establish SmithKline Beckman Cambridge Molecular Medicine Laboratories, which will perform research in molecular medicine.	SmithKline Beckman Box 7929 Philadelphia, PA 19101 (215) 751-4000
Wadley Technologies	Phillips 66 Biosciences	To form Wadley Biosciences, which will develop proteins to treat cancer, AIDS, and other viral diseases.	Wadley Biosciences 9000 Harry Hines Blvd. Dallas, TX 75235 (214) 351-8620

RESEARCH REPORTS

STUDY BY	TITLE	FORECAST	PRICE
Able Communications 515 Kevenaire Dr. Milpitas, CA 95035 (408) 945-1484	Network Management Systems (# N20)	The 1987 market of \$685 million will reach \$1.7 billion by 1991; segments will increase at differing rates.	\$1,600
Business Communications 25 Van Zant St. Norwalk, CT 06855 (203) 853-4266	High-Performance Fibers: Materials, Forms, New Developments, Applications, and Markets (# G8-069R)	The \$468-million U.S. market will approach \$1 billion by 1992, an average growth rate of 16.4 percent.	\$1,950
Business Technology Research Box 81210 Wellesley Hills, MA 02181 (617) 237-3111	Superconductive Materials and Devices	Several large-scale electronics applications offer significant potential for using superconductors. Reviews magnetic energy storage, magnetic separation, medical diagnostics.	\$1,950
Business Technology Research Box 81210 Wellesley Hills, MA 02181 (617) 237-3111	Computer-Aided Software Engineering: CASE	The market will increase 50 percent in 1988 over 1987 sales of \$102 million, and will reach \$600 million by 1990.	\$1,950
Datapro Research 1221 Ave. of the Americas New York, NY 10020 (212) 512-3851	Directory of Systems Houses and Computer OEMs	Prices of minicomputers and personal computers fell 48 percent as the number of systems sold grew 285 percent between 1985 and 1986.	\$795
Electronic Trend Publications 12930 Sorotoga Ave. Saratoga, CA 95070 (408) 996-7416	SMT Assembly-Equipment Market Trends	Consumption of equipment for surface-mount technology will grow from \$282 million in 1987 to \$756 million by 1992.	\$1,750
Electronicast 2121 S. El Camina Real San Mateo, CA 94403 (415) 572-1800	Hybrid Microwave Integrated Circuits: North American Production	Production of such circuits will rise 11 percent annually, from \$1.49 billion in 1987 to \$4.33 billion in 1997.	\$20,000
Frost & Sullivan 106 Fulton St. New York, NY 10038 (212) 233-1080	Bypass Alternatives and Networking Markets in the U.S. (# A1801)	Opportunities for end-users and manufacturers represent losses for telephone carriers; the market will reach \$212 million by 1991.	\$2,100
Input 1280 Villa St. Mountain View, CA 94041 (415) 961-3300	Software Products Market: 1987-1992	The market will increase from \$19.9 billion in 1987 to \$52.2 billion in 1992.	\$995
Market Intelligence Research 2525 Charleston Rd. Mountain View, CA 94043 (415) 961-9000	ISDN Strategies: Key Network Technologies for U.S. Market Transition (# A138N)	Reviews integrated-services digital network (ISDN) markets and technological advances; assesses both U.S. and international markets.	\$995
Market Intelligence Research 2525 Charleston Rd. Mountain View, CA 94043 (415) 961-9000	VLSI Through 1995: Market Analysis and Trends (# A347)	The market for analog GaAs integrated circuits will reach \$2.4 million by 1995. Covers materials, processing methods, quality control, production, and packaging.	\$2,950
Technology Futures 6034 W. Courtyard Dr. Austin, TX 78730 (512) 343-6468	Superconductivity: A Practical Guide for Decision Makers	Superconductivity markets will be driven not by the technology's most noted trait—low electrical resistance—but by a broad application base associated with cooperative electron effects.	\$595
Wilkerson Group 666 Third Ave. New York, NY 10017 (212) 973-2001	The Patient-Controlled Analgesia Market	This market for pain relief could reach \$100 million per year. Provides long-range information such as product life span, competition, and best time of market entry.	\$5,500

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Typing Tutor, Hands-Off Phone

OFFICE

Software sharpens typing skills

AS COMPUTERS become the commonest of office tools, even executives are realizing the benefits of learning to type. That process may be easier with the help of a tutoring program called Mavis Beacon Teaches Typing.

The program, made by Software Toolworks, is an expert system—a type of artificial-intelligence software that distills the know-how of an expert. The program keeps track of a person's progress and automatically customizes lessons to keep up with his or her progress and level of expertise. These lessons aim to entertain as they instruct. Instead of tedious letter and word drills, assignments consist of poems, riddles, and facts from the *Guinness Book of World Records*.

Two- and three-dimensional graphics help track a typist's progress and enliven a video game called Road Racer. The software also has a resume-writing program and includes style formats for business letters.

The program runs on IBM and compatible personal computers as well as on the Apple II, IIgs, and Macintosh, the Commodore Amiga and 64/128, and the Atari ST. It costs \$39.95 on 5¼-inch floppy disks and \$44.95 on 3½-inch disks.



Software takes the tedium out of learning to type.

Software Toolworks is located at 13557 Ventura Blvd., Sherman Oaks, CA 91423. Phone (818) 907-6789.

—Kenan Woods

A no-hands telephone

THE LITESET cordless telephone is made for business people who want to keep both hands free while talking. Its three-inch, half-ounce headset perches on a person's ear and extends only to about mid-cheek. Even so, the diminutive phone's acoustic quality matches that of full-size headsets, according to its maker, Plantronics Inc.

Wires attach the headset

to a 5½-ounce dialing pad that fits in a shirt pocket or clips to a belt. The third piece of the product is a base unit that can be placed as much as 1,000 feet away from the other units.

The headset portion also comes as an attachment for standard telephones; that version costs \$161 for a rotary-dial phone and \$198 for a touch-tone phone.

The \$219.95 Liteset is available at retail stores. Plantronics, which has designed headsets for astronauts, is located at 345 Encinal Street, Santa Cruz, CA 95060. Telephone (800) 538-0787; in California, dial (800) 662-3902.

—Jennifer Christensen



Toshiba's Sonic Jacket provides four speakers and an amp.

HOME

A stereo for wearing

TEND TO lose your Walkman? Tired from toting your boom box? Perhaps you should try on Toshiba's Tosbax Sonic Jacket, a cotton/polyester windbreaker that contains four speakers, wiring, and an amplifier. The jacket supports any portable compact-disc or cassette player, or a radio equipped with a jack for a standard stereo headphone.

Wearers slip their portable stereo into a pocket equipped with jacks that connect the player to four slender speakers—two at the chest and two at the shoulders. An amplifier in a front pocket powers the speakers. The system runs on four C-cell batteries, also concealed in the garment. All the hardware can be removed when the jacket needs cleaning.

To help assure comfort, Toshiba pads the pockets that hold the hardware. Other pockets on the sleeves and back provide extra storage.

When fully laden, the jacket weighs about nine pounds. It isn't the most practical piece of outerwear; Toshiba cautions that rain or snow might damage the sound system. The jacket comes in black or white and costs about \$200. Zip-out sleeves convert it into a vest.

Toshiba America Inc. is located at 82 Totowa Road, Wayne, NJ 07470. Telephone (201) 628-8000.

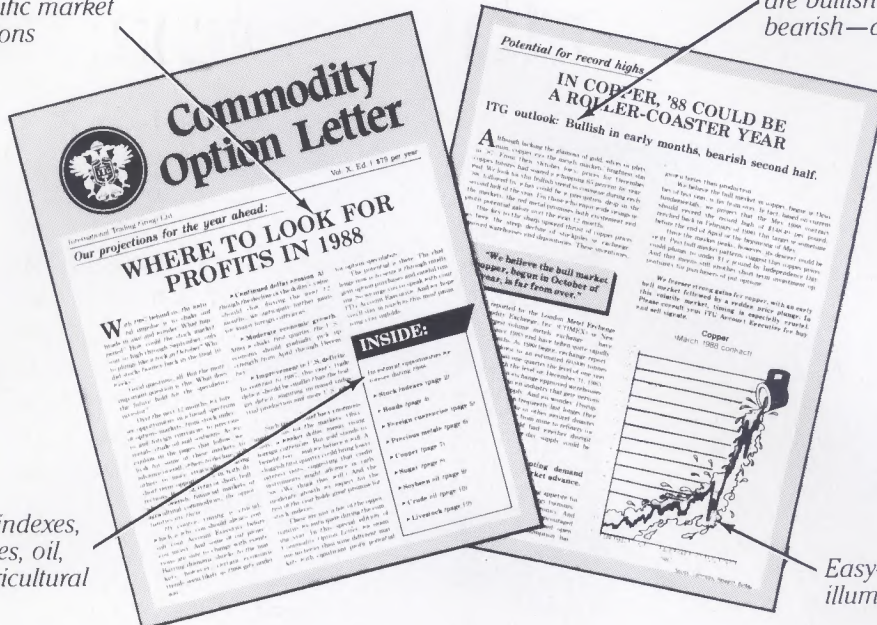
—Elizabeth Aaron

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